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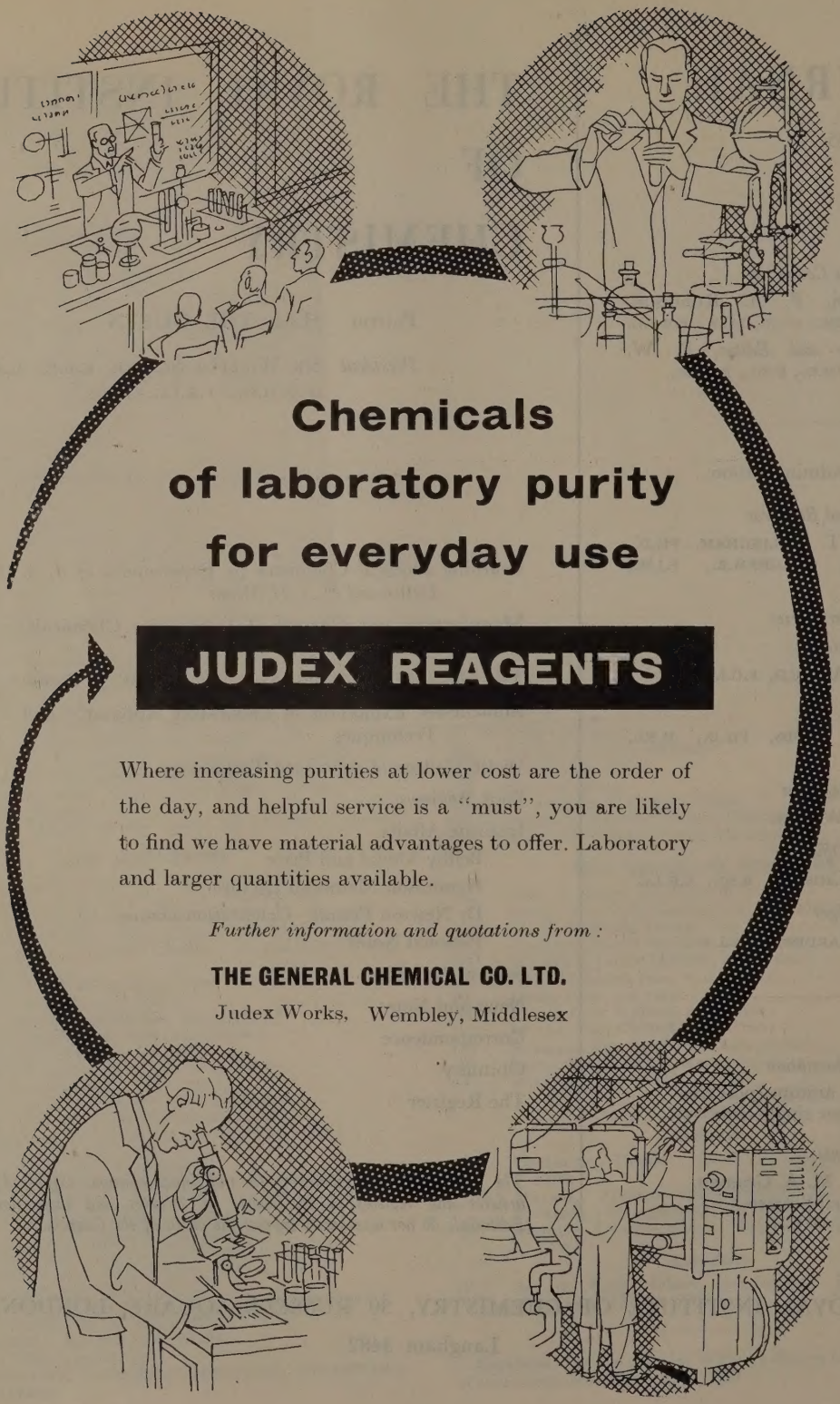

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LEARNING PHYSICAL CHEMISTRY BY EXPERIMENT

By J. A. Leisten, B.SC., PH.D. *and*
P. A. H. Wyatt, B.SC., PH.D.
Department of Chemistry, University of Sheffield

The main purpose of this article is to describe a laboratory course in physical chemistry specially designed to meet the problems encountered in teaching large classes. But first we shall consider the severe, and as yet unanswered, criticism of the role of laboratory work in training chemists made by Professor T. L. Cottrell in his inaugural lecture.[1] Many readers will surely have welcomed his stimulating attack upon the effectiveness of the accepted pattern of chemistry teaching in our universities; but in his strictures upon practical work we feel that he has gone too far.

There were two main criticisms. Firstly, the function of the industrial chemist is rather to plan research than to carry it out, so that the familiarity with apparatus and techniques which he may acquire through laboratory instruction is not an important gain. Secondly, considered in relation to the time occupied, laboratory work provides the least efficient way of teaching; and to support this contention reference is made to a study of methods of teaching pharmacology to medical students.[2]

Our reaction to the first criticism is that it does not bear upon the effectiveness of laboratory work as a way of teaching chemistry. As regards the second, we understand[3] that there are special features in practical pharmacology teaching which have no close parallel in chemistry. In particular, experiments on animal tissue require considerable skill in handling and often yield discouragingly unreproducible results. (One may doubt not only the extension of Joyce and Weatherall's conclusions[2] to chemistry, but even their future relevance to pharmacology; for there is a new trend towards human experiments which apparently enable students to obtain positive results, and which stimulate them to think and formulate questions. Few teachers, of any subject, would ask more than that.) Laboratory experiments are admittedly time-consuming; but if the results are challenging, and interest is aroused, the time is well spent. We feel that this is particularly true in a subject such as physical chemistry, which abounds in unfamiliar concepts, for it is the difficulty in absorbing new ideas rather than the bulk of work which daunts most students.

We believe that physical chemistry should be taught as far as possible in the laboratory, which we see as the natural focus for many of those activities which Professor Cottrell wishes to encourage. It is necessary however to examine critically the way in which laboratory teaching is generally conducted. It is usual in physical chemistry for a large number of students to work on separate experiments under the supervision of a small number of demonstrators. This type of course was originally designed when classes were much smaller, and it now has serious drawbacks: the results obtained by a student in a laboratory period are often too sparse to be of much value when he comes to work with them; and the difficulty of supervising a large class working independently discourages the demonstrators, and generally means that the students receive too little attention. In consequence the work tends to be carried out in a routine manner with the minimum of thought. There are doubtless many ways of overcoming these difficulties, and various solutions are appropriate at various stages in the students' training. Three new courses, each of quite different character, have been or are being introduced at Sheffield, and the one we now describe is designed for first-year physical chemistry students.

The course occupies nine days, spread over a term, and there are nine basic exercises chosen carefully in relation to the lecture courses. Four students (or four pairs if necessary) work simultaneously on one basic exercise, but with variations in apparatus and method which enable them to obtain distinct yet complementary results. The details of each set of apparatus and the writing of the instruction sheets were carefully planned to enable the average student to complete the experimental part of an exercise in about half a day: ample time then remains for the results to be gathered together and considered by the group. Towards the end of the day, at a time depending upon progress, the results and conclusions are discussed jointly with the demonstrator responsible for the exercise.

With this scheme a class of up to 72 students can be adequately supervised by three demonstrators, each taking charge of three exercises. Other important advantages are introduced by combining the results of each group. In this way the students cover more ground and verify relationships more convincingly than would otherwise be possible in a single laboratory period. Further, at the end of each exercise they have a worthwhile body of results which they must express clearly and interpret, in writing: this is excellent practice since it presents difficulties similar to those which most students will meet at a later stage when writing reports. (In

contrast, general essays impose a much looser discipline: passages can be borrowed from books and what is hard to express can usually be avoided.)

The exercises themselves are not novel, but the following details will give some idea of the teaching possibilities introduced by organized grouping. In some cases (conductance, electromotive force, homogeneous equilibria) primitive and more sophisticated forms of apparatus are deliberately placed side by side and used by different members of the group.

Solid–liquid Equilibria: a study of the two-component naphthalene – *p*-dichlorobenzene system. Two exercises cover different parts of the phase diagram by thermal analysis, whilst the third and fourth are devoted to the cryoscopy of naphthalene and *p*-dichlorobenzene as solvents. The object is to bring together ideas about cryoscopy, solubility and the phase rule: all members of the group draw a phase diagram and carry out calculations on cryoscopy and the ideal solubility formula, deriving values for the heats of fusion.

Liquid–vapour Equilibria: the variation, with temperature, of the vapour pressure of pure liquids. Experiments with chloroform, benzene, acetone and ethanol give scope for a discussion of the Clausius–Clapeyron equation, Trouton's rule, entropies of vaporization, and normal and associated liquids.

Temperature and Reaction Rate. First-order rate constants for the hydrogen peroxide – hydriodic acid reaction are determined by duplicate measurements at 20°, 25°, 30° and 35°, and a convincing Arrhenius plot is obtained. The discussion is on the first-order rate law and activation energy.

Concentration and Reaction Rate. The effects of the concentration of iodine, acetone and hydrochloric acid upon the rate of iodination of acetone are thoroughly investigated. The students encounter the kinetic effect of a large excess of one reactant; the distinctions between stoichiometry and mechanism, reaction order and molecularity; and homogeneous catalysis.

Conductance. The equivalent conductances of several concentrations of potassium chloride and acetic acid illustrate both the modern and Arrhenius theories. Some justification is given for calculating the dissociation constant of the acid by the Arrhenius theory. Conductance titrations are chosen to exemplify the detection of end-points produced both by changes in the number of ions and by mobility differences.

Electromotive Force. From measurements upon 0·1 M solutions against calomel half-cells, the standard potentials (corrected approximately for concentration) of zinc, copper and silver are considered in relation to the electromotive series. Some familiar chemistry is illustrated quantitatively by titrations involving the precipitation of silver halides (whose solubility products are calculated approximately), followed by the addition of ammonia or sodium thiosulphate. Permanganate, ceric, ferrous and ferrocyanide are used in oxidation–reduction titrations.

Thermochemistry: the calorimetric determination of heats of neutralization in aqueous solution. The results for pyridine – HNO_3, NaOH – HNO_3, pyridine – HCl, and KOH – HCl permit the calculation by Hess's law of the enthalpy of ionization of pyridine (inaccessible to direct measurement), and also lead to some discussion on strong and weak electrolytes and on dilution effects.

Homogeneous equilibria. Optical density measurements are made, using photoelectric absorptiometers, on solutions of different indicators in various buffer solutions, with the objects of determining acid dissociation constants, and of illustrating the step-wise use of indicators to cover wide ranges of acidity. Beer's law is also discussed.

Radioactivity and Atomic Spectra. (These two topics, though dissimilar, are conveniently covered in the same day.) The solubility-product relationship for strontium sulphate is investigated by determining the activity of ^{35}S in a series of solutions saturated with active strontium sulphate. The radioactive decay over the whole term is recorded and the decay constant ultimately determined. By means of a visual spectrometer, the wavelengths of three Balmer lines are recorded and used to discuss the quantization of energy in the hydrogen atom.

The spectroscopic experiment was prepared by Dr R. N. Dixon; much assistance with other experiments was given by the laboratory staff, and we were helpfully encouraged by Professor G. Porter, F.R.S.

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MANUFACTURE AND CONTROL OF LABORATORY CHEMICALS

By W. C. JOHNSON, M.B.E., F.R.I.C.*

The supplier of laboratory chemicals is committed, in the nature of things, to two particular and special responsibilities that distinguish his business from that of other chemical manufacturers. Firstly, he must maintain a very large range of products and, secondly, he must work to the very highest of purity standards.

To return to the first of these, the laboratory chemical supplier must catalogue and stock at least 5,000 items if he is to achieve a reputation as the universal provider for analytical and research laboratories. The job does not rest at that because new items lay claim to inclusion every week and there are always the requests for special, once-for-all, preparations which, within reason, must be met.

And how does the supplier come by these 5,000 or more chemical products? In three different ways. Some can be purchased in bulk. This applies to the commercial and technical grades and to certain other chemicals, the manufacture of which is a very highly specialized technique. The best example I can think of in this speciality class is hydrogen peroxide. Such materials are manufactured by special arrangement and are subject to careful quality control on each batch both by the manufacturer and the laboratory supplier.

The second, and more important source is the output of the so-called heavy chemical industries, obtained in bulk and then purified.

When, as a youth, I took my first steps in chemistry, I was taught that to purify a solid you recrystallize it; to purify a liquid you distil it; and if it is an insoluble precipitate you wash it. Perhaps it was this simple picture that encouraged me to throw in my lot with a concern whose business was to produce pure chemicals—it sounded a very easy life. But I was soon disillusioned and my disillusionment still continues. As many of us have come to realize, these elementary processes represent no royal road to the highest chemical purity.

To be quite fair to my preceptors, they had 'per cents' in mind when talking of impurities. Even then, of course, there are some separations that cannot be effected by recrystallization when isomorphism interferes, or by distillation when one is confronted by an azeotrope; and there are many other complications. These days, when the supplier is often concerned with the reduction of impurities to parts per million, these processes fail even more frequently. To take a very homely example, you can recrystallize technical sodium chloride time after time and still fail to reduce the sulphate content to a figure acceptable in an analytical reagent.

I do not wish to give the impression that recrystallization and redistillation are a dead loss. Far from it. One can still rely on them in the majority of instances. Recrystallization is usually carried out with the aid of glass-lined steam-jacketed vessels of up to 200 gallons capacity. Liquors are transferred through plastic-lined pumps and filters. Usually the concentrated solution is stirred mechanically while cooling and crystallization proceed. This agitation produces small crystals which occlude the minimum of liquor and, therefore, the minimum of impurities. Small granular crystals are also easier to pack and more convenient for the user to weigh out in small quantities. The crystals are freed from adherent mother liquor by spinning in hydro-extractors. These machines are lined, and their perforated baskets are covered with hard rubber or synthetic plastic to provide protection for both machine and chemicals, the former from corrosion and the latter from contamination by metals.

Glass-lined vessels are in almost exclusive use for neutral or acidic substances, but the vitreous lining has comparatively low resistance to alkalis, and caustic solutions must be handled in cast iron, nickel or nickel-clad iron. Fluorides are worked in silver-lined copper pans when heated by steam, but plastic vessels serve for cold solutions of fluorides and hydrofluoric acid. The plastics used vary considerably and PVC, epoxy resins on glass fibre, polythene, polypropylene and others have their various uses.

Most of this type of production is strictly batch-wise, but comparatively few chemicals have come into production on a scale that warrants the installation of a continuous crystallizer. This machine was constructed throughout in stainless steel of a special acid-resisting type. It consists of a long, narrow, stainless steel trough through the length of which runs a rotating helical system of stainless steel blades. The hot solution of the impure chemical is treated chemically as necessary and is then pumped through a filter into a steam-heated reservoir, from which it passes at a controlled rate through the trough. A current of cold water passes in the opposite direction through the jacket of the machine. The mush of crystals and liquor formed is finally pushed out by the blades on to a drainer. After spinning, the crystals are fed into a continuous drier—a rotating stainless-steel drum with internal fins through

* Lecture given to the East Africa Section, 5 October, 1960. Mr Johnson is chief chemist, Baird & Tatlock (London) Ltd, and technical director, Hopkin & Williams Ltd.

which passes a counter-current of warm filtered air. The product emerges suitable for immediate packing.

I have already remarked that straight recrystallization or distillation quite frequently fails to achieve the virtually complete elimination of certain impurities that is a necessity for many laboratory chemicals, particularly those that are used as analytical reagents. The solution of these problems does not always lie along the lines of textbook chemistry. As often as not one might describe the process, or the vital part of it, as a trick of the trade.

The problem with sodium chloride is settled in a fairly simple manner. The salt is crystallized from a solution made acid with hydrochloric acid, and the sulphate then remains in the mother liquor.

When it is a question of eliminating nickel from cobalt salts it is a far more complicated matter. Recrystallization is ineffective. The separation is achieved by converting the salts to co-ordination compounds, from which the nickel is more readily eliminated. The cobalt complex is then decomposed with sodium hydroxide to obtain cobalt oxide, which is dissolved in the appropriate acid to obtain the desired salt.

The salts of some other metals are liable to contain nickel, *e.g.* salts of cadmium and of manganese, but here it is possible to use selective precipitation. Nioxime, which was originally developed as an analytical reagent, will precipitate nickel in the slightly acid solutions of salts of these metals, and a clean separation can be effected. Dimethylglyoxime will not serve this purpose. It will not precipitate nickel under the acid conditions that obtain in solutions of the salts of the heavier metals.

The selection of raw material is often of first importance. The starting material for the manufacture of magnesium salts can contain any amount of iron, for this impurity can be precipitated, but even a fractional percentage of sodium or potassium will give far more trouble than 1 per cent of iron. Close co-operation is obviously necessary, therefore, between analytical laboratory, buying department and factory.

In point of fact, reagent-grade magnesium salts, the chloride and nitrate at least, are not usually produced by recrystallizing the cheap commercial salts. These contain sulphate, potassium, sodium and other impurities that are so difficult to remove that it is more economic to start with the purest obtainable magnesium carbonate and dissolve it in the appropriate pure acid.

Then, as I have said, redistillation is no panacea for impurities in liquid chemicals. Water, even in minute traces, is often a most objectionable impurity, and we are all familiar with the elimination of water from ether by the also objectionable but usual sodium treatment. That has been going on for a long time, but a more recent demand has asserted itself for methanol with a water content less than 0·05 per cent for use as a solvent in the titration of moisture by the Karl Fischer method. In spite of the disparity between the boiling points of methanol (65°) and water (100°), fractionation is not the best practical proposition for reaching this very low figure. It is preferable to treat the alcohol with a slight excess of magnesium metal, which reacts with the trace of water to give hydrogen and magnesium oxide, the reaction being catalysed by a trace of iodine. The magnesium oxide is removed by filtration and the methanol is distilled. The filtration and distillation must be carried out with careful protection from atmospheric moisture, otherwise the methanol may easily pick up as much moisture as has been removed from it, or even more.

Another type of purification procedure deserves special mention as being modern and very effective in those instances where it is applicable. This is the zone-refining process, which has assumed such importance in the purification of some of the metals used in the manufacture of transistors. The commercial apparatus used is adapted to the lower melting points encountered with organic chemicals.

The third classification of products comprises those that are actually manufactured from more or less basic raw materials. These preparations vary from the simple case of the magnesium salts, prepared from the carbonate by the most elementary of chemical processes, to multi-stage organic syntheses such as that involved, for example, in the manufacture of dithiol, which is a seven-stage process.

One frequent and important reason for making a product from more elementary materials is that it is often more economic to start with reasonably pure intermediates, or raw materials, and actually make the chemical, than attempt to purify the technical or commercial grade of the product. Magnesium salts have already been mentioned as a simple example of this. At the other extreme I would instance the organic dyes that are used as biological stains and for a few other scientific purposes. Only a relatively small proportion of organic dyes are amenable to purification by recrystallization and it is for this reason that we find ourselves making quite a number of biological stains from purified intermediates—none too eagerly, because dyes in a chemical works are quite a menace.

A most important speciality is perchloric acid, which is manufactured on a tonnage scale. Two processes are available. One consists of the treatment of sodium perchlorate with hydrochloric acid. Double decomposition occurs, with the formation of perchloric acid and sodium chloride, and the bulk of the latter is precipitated with excess hydrochloric acid. The excess of hydrochloric acid is removed by distillation. In the other process, the Willard process, ammonium perchlorate is used. The ammonium radical is oxidized to nitrogen and its volatile oxides by means of a mixture of hydrochloric acid and nitric acid. All the by-products are much more volatile than perchloric acid and are removed by heat. Whichever process is used the purer

grades of perchloric acid must be obtained by distillation, which is carried out at low pressure and at 160–170° for the constant-boiling 72 per cent acid. This distillation is carried out in all-glass stills and the whole of the perchloric acid plant is constructed in cement, brickwork and metal, since wood or any other organic material would take fire explosively in the event of a spill.

A large supplier may conduct many hundreds of manufacturing processes, and it is difficult to give even a brief overall picture of the range. Inorganic preparations may cover many hundreds of acids and alkalis and their combinations as salts. Organic preparations may be as numerous and include most classes of organic substances from the simpler substituted hydrocarbons, such as bromobenzene and bromonaphthalene, to the more complicated indicators and reagents of recent times. The sulphonphthalein indicators are prepared by the condensation of a whole series of phenols with *o*-sulphobenzoic anhydride, which is itself obtained by a synthesis involving several stages. The organic isothiocyanates are obtained by treating various amines with phosgene, and 1 : 10-phenanthroline and its methyl and ethyl derivatives are obtained by variants on the classic Skraup synthesis.

Some organic reagents, such as cupferron and dimethylglyoxime, are made on the kilogram scale in vessels up to 50-gallon capacity. Others, in smaller demand, are prepared in batches of only a hundred or two grams or sometimes less, in large-scale laboratory glassware, that is to say, in flasks of up to 10 and 20-litre capacity. Glass has the great advantage of permitting careful observation of the progress of a reaction, and the restriction it imposes on batch size is often unimportant considering the modest demand for many reagents. Moreover, such apparatus is versatile and can be adapted to meet the manifold needs of our work.

Versatility in both plant and staff must be an important aim. Most chemical factories can specialize in a few types of product or a few types of chemical reaction, but reagent chemicals can fall into any classification from a preparative point of view. Glass-lined steel or glass-lined cast-iron vessels have already been referred to as of fairly universal application for evaporating pans and reaction vessels. Plastic vessels are comparatively cheap and are ideal for some precipitation reactions, for instance, in the preparation of carbonates of calcium, barium and strontium. Such vessels run up to 500 gallons capacity. The precipitates are washed first by decantation in the plastic vats and are finally spun in a hydro-extractor. Alternatively, the filter press is used for the separation of some solid products. In either event the drying process is completed in steam-heated cupboards.

The translation of a chemical process from laboratory scale, through pilot-plant scale, to works scale usually gives rise to a number of teething troubles, some of which can be anticipated and some of which may be quite unexpected. A simple but common case arises when a solution has to be concentrated by evaporation. Such a process may be completed in an hour or less on the laboratory scale, but in the works a much greater volume is in process and, if a similar means of evaporation is employed, the solution is held at boiling point for many hours. Many products are more or less unstable and such treatment can result in serious loss of yield and an impure end-product. The difficulty can be partly overcome by low-temperature evaporation in a still, and this is a much-favoured method, even with stable substances. But the ideal method makes use of the climbing film evaporator. The solution to be evaporated is drawn from a container by vacuum through a number of vertical tubes in parallel surrounded by a steam jacket. Evaporation takes place very rapidly under vacuum and the mixture of vapour and liquid spray is separated by a glass cyclone whence the vapour is condensed into a closed receiver and the concentrated liquor is collected in a closed flask with a bottom outlet. The great advantages are the low temperature and the very short period of heating.

Passing on to the control of these manufactures I think it can well be imagined that a very extensive and complex analytical organization is necessary to check the purity of purchased materials, to control operations in the factory and to ensure that finished products comply with purity standards.

The analytical laboratory in the works will examine materials, provide analytical service to works processes and check products for the more likely impurities, but the main analytical laboratory will be responsible for final analysis and for passing the products for sale, so that on some of the more critical aspects of purity a double check is obtained. The final analytical control is never governed by production management.

The analytical services will deal not only with the routine testing of materials and products but also with the investigation and continual improvement of test methods and purity standards.

Finally, I would like to add a few words about the packaging of laboratory chemicals, which is, after all, part of the production chain.

In many ways and directions demands are becoming more and more exacting and many special and improved methods of packaging have become necessary. For example, it is no use reducing the lead limit in various acids to less than one part in two hundred million and then putting them in ordinary glass bottles. Special lead-free glass bottles must be used.

Liquids naturally present the greater difficulties from a packaging point of view. Hydrogen peroxide in glass bottles always constitutes a potential menace, and explosions have been reported even on the home market. Blown polythene bottles are useful for hundred-volume hydrogen peroxide, because of the reduced risk in the event of the bottle bursting. Flying glass constitutes a

greater personal hazard than splashes of the hydrogen peroxide itself.

Much attention has been devoted to screwcaps for acid winchesters because ground-glass stoppers are becoming impossible. They are increasingly difficult to obtain, and are often badly ground. Also, it is necessary to tie a stopper over or wire it for export, and corrosion of the wire (and several different metals have been tried) leads to all kinds of trouble, such as leakage and contamination. The most satisfactory cap is perhaps the polythene screw-cap containing a PTFE (polytetrafluoroethylene) disc. The acid is in contact only with the PTFE, which is completely resistant to attack, and contamination and discoloration of the acid are completely prevented.

A polythene shive is useful for wide-mouth bottles containing solids that must be well protected from atmospheric moisture and carbon dioxide. This replaces the old waxed wood-cork shive that was a source of trouble both to supplier and customer, for on opening the bottle scraps of paraffin and cork could easily be dropped into the chemical. It is also useful for some solids that give off corrosive vapours.

Though considerable advances in packaging are being made there is much more that can be done, and investigations are continuing.

The market for ultra-pure chemicals is not these days confined to analytical and research laboratories. Many of the newer industries require materials in this category for production processes—the transistor manufacturers, the makers of fluorescent lighting tubes and others. The manufacturer of laboratory chemicals has the plant, organization, skill and experience for this type of production, and he is increasingly and very willingly involved in the bulk manufacture of special chemicals for the more modern scientific industries.

THE ALKALI ACTS AND THEIR APPLICATION

By W. A. DAMON, C.B.E., B.SC., F.R.I.C.

Formerly Chief Alkali Inspector, Ministry of Housing and Local Government

Air pollution can be described in a number of ways but for practical purposes a useful definition is that adopted by the Manufacturing Chemists' Association in the United States, and published in its manual.[1]

> 'Air pollution is the presence in the air of substances put there by acts of man, in concentrations sufficient to interfere with the comfort, safety or health of man, or with the full use and enjoyment of his property'.

Air pollution may be caused by solid, liquid or gaseous contaminants. Solids and liquids entrained by waste gases and ejected with them into the atmosphere may be in the form of relatively large particles (grit) which will be deposited on the ground within a short distance of their point of emission. Finer particles (dust) will be carried greater distances downwind or may remain suspended in the air for an indefinite period. Unless the mass rate of emission of contaminants is strictly controlled, such pollution may result in serious effects on health and property. Although the most massive pollution arises from the combustion of fuel, yet that caused by certain other industrial operations (*e.g.* chemical processes) may have a more serious local effect, and the control of the latter poses a number of particularly difficult problems.

It is important that those responsible should be aware of their statutory obligations in this connection, particularly those imposed by:

(i) The Public Health Act, 1936, Part III of which deals with statutory nuisances;

(ii) The Clean Air Act, 1956, which deals with pollution by smoke, grit and dust caused by the combustion of fuel; and

(iii) The Alkali Acts,[2] which control the discharge to the atmosphere of noxious or offensive gases from a variety of industrial operations.

THE ALKALI ACTS

The original Act of 1863 was extended and consolidated at various dates and culminated in the current Act of 1906, which itself has been further extended during the past 30 years by taking advantage of the powers given in Section 4 of the Public Health (Smoke Abatement) Act, 1926. At the end of 1959, the Acts applied to at least 3,876 separate processes operated in 2,538 works in Great Britain.

Broadly speaking, the Alkali Acts hitherto have related to noxious or offensive gases produced in chemical or allied processes and not to smoke, grit or dust produced by the combustion of fuel. The provisions of Section 17 of the Clean Air Act have, however, made the Alkali Inspectorate responsible also for smoke, grit or dust emitted from any furnace which is an integral part of a registered process, *e.g.* from tar stills and salt

cake furnaces. Moreover, certain processes in which smoke prevention is a matter of exceptional technical difficulty have been excluded from the Clean Air Act and (by Order) have been made subject to the Alkali Act. Thus, the owners of these works are bound by the same restrictions in regard to the emission of smoke, grit and dust as of noxious and offensive gases.

THE ALKALI INSPECTORATE

For the administration of the Alkali Act, England and Wales is divided into 12 districts, each of which is in charge of a resident Inspector (sometimes with an assistant); the Chief Inspector and his two deputies exercise general control from London. In Scotland, the corresponding Act is administered by the Chief Alkali Inspector for Scotland, with two District Inspectors to assist him. The Secretary of State for Scotland exercises similar powers to those of the Minister of Housing and Local Government in England.

Inspectors are usually recruited from industry at 30 to 40 years of age. They must be University graduates or corporate members of the Royal Institute of Chemistry and/or the Institution of Chemical Engineers and/or the Institute of Fuel. They must have substantial practical experience in the operation and control of chemical processes.

REQUIREMENTS OF THE ALKALI ACTS

The essential provisions of the Alkali Acts are, briefly:

(i) Certain processes that are considered to be potentially serious contributors to air pollution must not be operated until the owner has secured a certificate of registration from the Ministry of Housing and Local Government. These processes are closely defined in a schedule to the Act.[3]

(ii) As a prior condition of registration, the owner must satisfy the Chief Inspector that the process is designed and furnished with such appliances as are necessary to enable it to be operated in conformity with the provisions of the Act, that is to say, that the plant is equipped with the 'best practicable means' for minimizing the discharge to air of any noxious or offensive gas[3] and for discharging the irreducible residue in such manner as to cause the least possible damage or annoyance.

(iii) The expression 'best practicable means' is so defined that it applies not only to the control of noxious gaseous discharges but also to the proper supervision of the processes in which such gases are produced. This is important: in many processes the quantity of noxious gas discharged is inversely proportional to the efficiency with which the process is conducted.

(iv) The means thus furnished must be maintained in good order and continuous operation.

(v) Certain statutory limits are prescribed for the concentration of acids in waste gas, *viz.*

Alkali (salt cake) processes	0·2 grain HCl/ft³ chimney gas.
Sulphuric acid concentration processes	1·5 grain total acidity (calculated as SO_3) per ft³ chimney gas.
Sulphuric acid processes employing oxides of nitrogen	4 grains total acidity (calculated as SO_3) per ft³ gases leaving the last Gay-Lussac tower, *i.e.* before any dilution with other gases.

(vi) Registered works are subject to inspection at any reasonable time. The owner must afford all facilities for entry, inspection, examination and testing. He must disclose any details of the process that may be required by the Inspector but such details are to be regarded as strictly confidential. Inspectors are bound by the Official Secrets Act.

(vii) The Chief Inspectors must report annually to their Ministers on the work of the Department and their reports must be laid before both Houses of Parliament. They are then published. The anonymity of individual works is preserved, as necessary, by referring to them under key numbers.

Statutorily, the duty of securing compliance with the provisions of the Alkali Act rests with the owner (defined as including any lessee, occupier or other person carrying on the work). In practice, the onus falls in great measure on the operators of the plant and the chemist in charge.

PRACTICAL APPLICATION

In some of the older processes, satisfactory methods for dealing with noxious or offensive gases are well established but processes are constantly being changed and new techniques developed so that fresh problems are continuously presented. In any such case, the chemist in charge should carefully consider the following points:

(i) Can the evolution of gas be avoided altogether or to some extent suppressed—without affecting the main product—by

- (*a*) using different raw materials,
- (*b*) changing the conditions of operation,
- (*c*) improving the design of the plant,
- (*d*) effecting closer supervision.

(ii) Can the gas be satisfactorily dealt with by

- (*a*) absorption and subsequent recovery, *e.g.* recovery of solvents by active carbon, of

hydrogen sulphide by ethanolamine and so on;

(*b*) treatment whereby a saleable by-product results, for example production of sulphites from SO_2, of sulphur from H_2S, of nitric acid from oxides of nitrogen;

(*c*) absorption and subsequent disposal to waste, *e.g.* production of weak acids or salts of no value (unless adequate facilities are available, this may involve another problem in liquid effluent disposal);

(*d*) direct destruction, for example, by combustion or by the use of an oxidizing agent.

(iii) Having reduced the quantity of gas to the practicable minimum, can this residue be discharged in such a manner as to cause no inconvenience to local residents, *e.g.* by dilution with other hot waste gases and final discharge through a sufficiently high chimney.

The dispersal of gases as they flow downwind from their point of emission has been studied and it has been established that, under ideal conditions, the maximum concentration at ground level will vary directly with the mass rate of emission and inversely with the wind speed and the square of the chimney height (adding to this height the vertical distance above the chimney top to which the gases rise).[4] In practice, there are many other factors which must be taken into account, notably the degree of turbulence in the atmosphere. Under a condition of temperature inversion, the air is stable and gas discharged into it is liable to form a layer under the inversion, undergoing little dilution as it travels downwind. Even if the gases are discharged at a height, downdraughts induced by rising ground and high structures may cause them to descend rapidly to ground level. For this reason local conditions and topography must be carefully studied.

ROUTINE TESTS AND RECORDS

The chemist should see that routine tests include frequent examination of any noxious gas which has to be discharged to air, both as regards concentration and mass rate of emission. With an intermittent process, a series of estimations should be made in order to establish the general pattern of gas evolution and especially the times at which peaks occur. Whenever possible, an automatic continuously recording instrument should be used. If this is not feasible, the results of hand tests should be recorded for the information of the Inspector. Any circumstances that might explain an unusual emission (*e.g.* breakdown) should also be logged, together with a note of the corrective action taken.

It is desirable that a record should be kept of local weather conditions, particularly wind direction. These can be of vital importance in dealing with complaints. In cases of persistent complaint, it may be necessary to set up monitoring stations in the neighbourhood of the works.

DUSTY OR MISTY GASES

Similar considerations apply to emissions containing dust or persistent mist. The separation of solid or liquid particles from waste gases is an important part of air pollution control. Removal of coarse grit presents no serious technical problem, but the separation of finely divided dusts, fumes or mists is difficult, both technically and economically.

Separation can be effected in many different ways—gravity settlement, cyclonic devices, wet scrubbers, filters and electrical precipitation—and there is an extensive literature on the subject.[5] Every case should be considered in the light of local conditions and circumstances.

Routine determinations are a matter of difficulty because dust suspended in a gas is not necessarily uniformly distributed, and elaborate precautions must be taken to ensure that the sample tested is truly representative. However, with the exercise of a little patience and ingenuity, the chemist will usually be able to devise some rough tests which will afford useful indications of the conditions, *e.g.* the exposure of sticky glass plates or pieces of sensitized paper.

CONCLUSION

The development of industry is inevitably accompanied by some loss of amenities, which may include a degree of air pollution. The manufacturers must, however, employ the best practicable means whereby such pollution and its effects are minimized.

In planning new processes, the provision of suitable control measures should be regarded as one of the first essentials. Good equipment of ample capacity should be installed at the outset. The replacement of an inferior device is likely to prove more expensive than the provision of a better one in the first instance would have been, and a capacity that is only just sufficient at the outset will not cope with the increased output that is normally hoped for in the future.

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MANCHESTER EXHIBITION OF LABORATORY APPARATUS AND TECHNIQUES

The Manchester and District Section of the Institute held its Annual Exhibition of Laboratory Apparatus and Techniques at the Manchester College of Science and Technology on 6 and 7 April. This event has been growing in popularity over the last few years and an increased number of visitors was recorded. Again on this occasion many firms were exhibiting for the first time.

Visitors found that all aspects of laboratory design and equipment were represented. The first requirement

Visitors at the Exhibition

of any laboratory is the benches, and a comprehensive range was on show at the stand of Cygnet Joinery Ltd. Bench fittings were also exhibited by Donald Brown (Brownall) Ltd. The range of balances on display included those from Stanton Instruments Ltd and the unique Quartz Fibre Decimicrobalance exhibited by L. Oertling Ltd. There would be no difficulty in equipping the laboratory from the extensive range of glassware and bench equipment on display. Exhibitors in this category included: Baird and Tatlock (London) Ltd, Camlab (Glass) Ltd, Davy and Moore Ltd, Electrothermal Engineering Ltd, Eureka Scientific Co. Ltd, H. J. Elliott Ltd, W. G. Flaig & Sons Ltd, James A. Jobling & Co. Ltd, Laboratory Apparatus and Glass Blowing Co., Orme Scientific Ltd, J. Preston Ltd, Quickfit and Quartz Ltd, Research Utilities Ltd, Rotameter Manufacturing Co. Ltd, The Thermal Syndicate Ltd, J. W. Towers & Co. Ltd, Townson and Mercer Ltd, Wood Brothers, Glass Co. Ltd. No laboratory is complete without a range of ovens and these requirements could be met easily from those displayed by: Griffin and George (Sales) Ltd, Laboratory Thermal Equipment Ltd and R. E. Pickstone Ltd. This latter supplier specializes in inexpensive ovens costing about £26.

Many stands indicated that the use of electronics is now a well-established feature of chemical laboratories. Instruments exhibited by Chandos Products (Scientific) Ltd, Doran Instrument Co. Ltd, Electronic Instruments Ltd, A. M. Lock & Co. Ltd and Southern Analytical Ltd are making a major contribution to the facilities available to the chemist. In the optical field similar high-grade instruments were displayed, including contributions by Flatters and Garnett Ltd, W. F. Stanley & Co. Ltd, The Tintometer Ltd and W. Watson & Sons Ltd. The visitor interested in spectrophotometry had a unique opportunity of comparing the instruments of Perkin Elmer Ltd and Unicam Instruments Ltd. The chemist often needs specialized advice on the choice of a suitable instrument for a particular application and this was readily available at the stand of The Scientific Instrument Manufacturers Association.

The chemist whose work lies in the field of vacuum techniques found the stands of D. A. Gunn (Engineering) Ltd and N. G. N. Electrical Ltd of particular interest. The heavier laboratory apparatus included the display of autoclaves by Baskerville and Lindsey Ltd, Chas. W. Cook & Sons Ltd, filter presses by J. C. Carlson Ltd and mixers by Winkworth Machinery Ltd and Silverson Machines (Sales) Ltd.

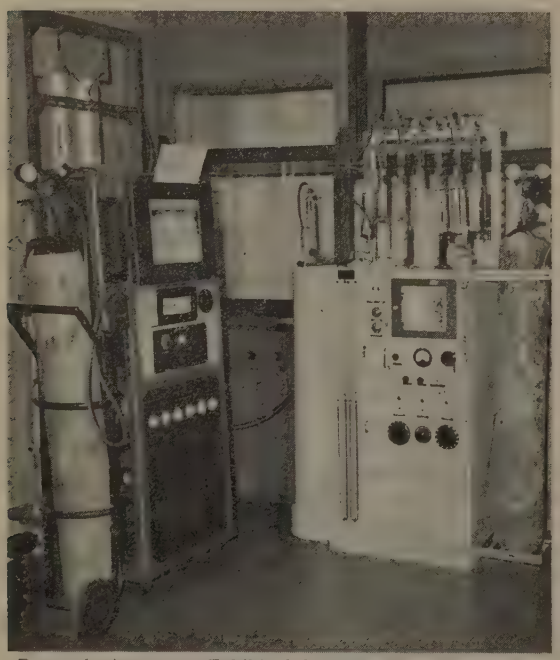
Every chemist will acknowledge his dependence upon the book-publishing industry and the stand of Haigh and Hochland Ltd, with its large display of scientific books, was a centre of great interest.

A new feature of this year's exhibition was a laboratory devoted to research exhibitors. Manchester is fortunate in that advanced research is being carried out at a number of local centres in industry, the university and research associations. It is proposed each year to invite a number of these centres to display a non-commercial apparatus illustrating some recent advances and/or showing research experiments in progress. The Chloride Electrical Storage Co. Ltd had lent an apparatus in which the factors affecting the efficiency of the electrochemical reduction of lead sulphate to metallic lead were being investigated. Three aspects of this process were being studied. Measurements were made of the potential of hydrogen evolution on surfaces partially covered with lead sulphate. The establishment of these potentials on initiating the polarizing current was recorded on an oscilloscope and similarly the decay of the potential was recorded when the current was interrupted. The current produced hydrogen gas

and reduced the lead sulphate on the surface. That component of the current which produced hydrogen was determined by collecting the gas in a stream of argon and

Research Apparatus Exhibited by the Chloride Electrical Storage Co. Ltd

analysing the mixture in a gas chromatograph. The ease and high order of accuracy with which the permanent gases could be analysed in such a compact



Research Apparatus Exhibited by Manchester College of Science and Technology

chromatograph aroused considerable interest. These researches are the work of Dr M. Barak (Fellow), Dr M. I. Gillibrand (Fellow) and Mr B. E. Wilde (Associate), and some results in this field have already been published.

A chromatograph of a different type was provided by Dr R. E. Banks (Associate) of the Manchester College of Science and Technology. This apparatus was designed for the large-scale analysis of complex organic mixtures. It consisted of a 1-in diameter column, 20 ft long, in the form of a folded W and packed with dinonyl phthalate absorbed on Celite. Nitrogen was used as a carrier gas and the products were detected by katharometers containing thermistors. Several grams of a complex organic mixture could be separated into its components in about an hour and these components were condensed separately in glass traps cooled in liquid nitrogen.

Spectrum Display Comparator (Magnesium Elektron Ltd)

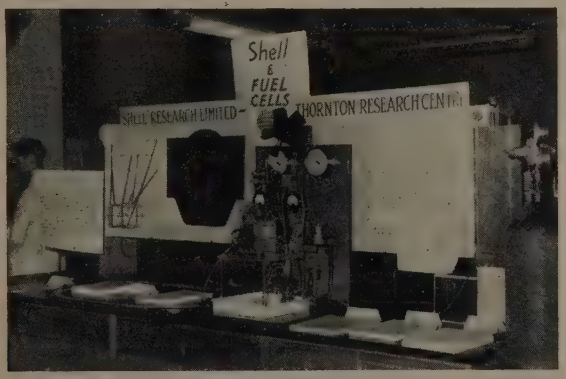
Magnesium Elektron Ltd contributed an instrument for the display of spectra which had been developed by Mr W. J. Price and his colleagues. The problem here was to evaluate a large number of photographs of spectra in which the analytical lines are of low optical density and adjacent to intense lines arising from the matrix. The negatives were illuminated and scanned by a moving optical slit. The variation in transmitted light was detected by a photoelectric cell behind the slit

and converted into an electrical impulse by means of electronic amplifiers. These signals were then fed into a cathode-ray oscilloscope with a long persistent tube.

Zone Refining by I.C.I. Ltd

The visitors' interest was centred on the ease and rapidity with which the spectra could be interpreted and measured.

The technique of zone refining has developed rapidly over the last decade and has been of considerable use to the chemist. I.C.I. Ltd provided a display which illustrated these principles in the purification of organic compounds. Compounds that are difficult to purify by other means were given as examples.



Shell Fuel Battery

An exhibit that caused considerable interest was the model of a fuel battery displayed by Shell Research Ltd. This battery has been developed by Dr K. R. Williams and his colleagues. It consists of 12 fuel cells using oxygen and hydrogen. The output of the battery was 2A at 6V, and this was used to drive an electric fan. Visitors were impressed by the battery design and the amount of power available from such a small unit. Those who were also railway enthusiasts had a double treat when the output of the unit was used to drive a model electric train. In view of the tremendous possibilities in the use of fuel cells and the rapid strides made over the last three or four years, it is not surprising that this exhibit stimulated a considerable number of questions from interested visitors.

The Shirley Institute provided an apparatus for the study of the respiration of fungus on cotton. This machine, developed by Dr C. Maitland and Mr K. Selby, can be used for investigating any reaction that consumes oxygen, such as the oxidation of iron. The oxygen-consuming material is placed in a detachable vessel connected by a U-tube to a similar vessel containing air which acts as a reference. The oxygen consumed is replaced in pre-determined doses by

Automatic Respirometer (Shirley Institute)

electrolysis, in the limb of the U-tube. This electrolysis was actuated by a second electrode in the U-tube which kept the level constant. The number of doses necessary to do this was recorded on a 10-channel recorder. Each channel was connected to a separate reaction vessel. This exhibit was a very good example of the use of automatic equipment in research work.

It is not possible to comment on every stand at such a large exhibition, and we are sure that this will be appreciated by those exhibitors who have not been mentioned in this report. The organizers, Mr Heslop, Dr Ward and Mr Young, are to be congratulated upon this very fine exhibition.

M. I. G.

WELSH COLLEGE OF ADVANCED TECHNOLOGY

The extension to the Welsh College of Advanced Technology was officially opened by the Duke of Edinburgh on 2 June. Among those present were Alderman E. Ewart Pearce, Lord Mayor of Cardiff, Colonel C. G. Traherne, President of the College, Councillor Llewelyn Jenkins, Chairman of the Governing Body, Dr A. Harvey, Principal of the College, the Rt Hon. Henry Brooke and the Rt Hon. Lord Brecon. Mr P. J. C. Haywood, in his capacity of Member of the Governing Body, represented the Institute.

The new building, which together with its equipment has cost some £850,000, is situated in Cathays Park, near to the old building. To it have now been transferred the departments of chemistry and biology, pharmacy and navigation. In addition, the building houses extensive Students' Union premises, the college refectory and an assembly and examination hall capable of seating 800 persons.

The department of chemistry and biology occupies the east side of the building. Accommodation consists of 10 teaching and four research laboratories with various instrument and balance rooms; there are two lecture theatres and two tutorial rooms, and other non-departmental lecture rooms are also available. Some 120 full-time or sandwich students will be accommodated in addition to those taking ancillary or part-time courses.

In planning teaching laboratories, special consideration has been given to their efficiency in operation. Thus four individual apparatus lockers are provided for each student place; each locker is comprehensively equipped for inorganic, analytical and organic chemistry. By the use of small reagent bottles each student is provided with an unusually extensive range of reagents and materials. A centrifuge and a drying oven are directly available at each student place. Kneehole space is provided so that work may be carried out seated and recording of results facilitated. Four specialized laboratories cater for instruction in analytical chemistry, polymer technology and radiochemistry.

All laboratories are liberally provided with gas, water and electric points; piped vacuum is available at each working place. Demineralized water is provided on tap in each laboratory from a central semi-automatic plant. All laboratory drainage is in glass. A. H. H.

Book Reviews

THE THEORY OF TRANSITION-METAL IONS. J. S. Griffith. Pp. x + 455. *Cambridge: University Press*, 1961. 95*s*.

The publication of this book is a significant event for anyone interested in transition-metal ions and their complexes. In its field it seems likely to be as important as Condon and Shortley's *The Theory of Atomic Spectra*, with which in many ways it invites comparison. It is authoritative and largely complete, and is a splendid example of the high-quality productions of the Cambridge University Press.

The first five chapters of Dr Griffith's book may properly be regarded as an up-to-date presentation of much of the theory of free atoms and as a successor to those parts of 'Condon and Shortley' dealing with *L.S* coupling. There then follows a long chapter on groups and their matrix representations, a subject which does not need to be treated in dealing with the theory of free atoms and ions but which is essential in fields of lower symmetry imposed upon the ions in metal complexes.

The second half of the text is about the properties of transition-metal ions in fields of non-spherical symmetry, with special reference to the crystal-field approximation to the effects of ligands in complex compounds. The six chapters in this part of the book deal with the weak and strong coupling schemes, magnetic susceptibilities, optical spectra and thermodynamics and paramagnetic resonance. Finally, there are several valuable appendixes.

The subject of the ligand-field theory of metal complexes spans a very wide range of activities and skills, from the experimental chemist on the one side to the theoretical physicist on the other, and no book could appeal right across this spectrum. This one is addressed to theoretical chemists and physicists, and although Dr Griffith strikes the encouraging note in his introduction that only a little prior knowledge of quantum mechanics is needed, that little proves to be of a sophisticated kind which may put a limit on the number and type of readers who will get the most from the book. On the other hand, there is a lucidity about the writing which encourages sustained study, and this, together with a full step-by-step presentation of arguments, will make the book an excellent teaching medium.

The book contains many new and original methods and results. Dr Griffith exploits symmetry arguments more fully than usual and so brings out explicitly many relations that often go unrecognized as special cases in the course of calculations by more elementary methods. Most of the results of the application of ligand-field theory to particular ions can be reached through quite simple perturbation devices, which lead to the right result without illuminating the underlying physical situation. This book is the expression of an attitude diametrically opposed to such *ad hoc* methods. It is above all devoted to displaying physical situations in general rather than special terms and so to bringing out the broad essential connections between the types of phenomena that occur and to showing how they arise from the fundamental characters of the ions. The gain in understanding from seeing the theory presented in the more generalized form is striking and reminds one in a smaller way of the gain from the presentation of Newton's laws in Lagrangian form instead of in the equations of schoolboy mechanics. In this the book is wholly successful and most welcome.

The high standard of writing occasionally lapses in the footnotes, in which the author's use of the first person singular sometimes descends to the level of mere reminiscence, as in describing how and where he first learned about the material he is discussing in the text. These entries have an odd flavour of self-involvement unworthy of the text as a whole which, in other respects, has the quality of disinterestedness found in the best scientific writing.

D. P. CRAIG

DIE ELEKTRONENSPEKTREN IN DER THEORETISCHEN CHEMIE. C. Sandorfy. Translated by H. v. Hirschhausen. Pp. x + 208. *Weinheim: Verlag Chemie GmbH*, 1961. DM 28.

The interpretation of the electronic spectra of conjugated organic molecules in terms of quantum mechanical concepts and the calculation of molecular parameters therefrom has been a field of great activity during the past 20 years. Many schools of theoretical chemists have developed special techniques for dealing with the complicated problems which arise, and their results have thrown considerable light on the electronic structure and chemical behaviour of organic molecules. While there have been very many good review articles on various aspects of the subject, there has been no previous book that begins at an elementary level and proceeds to treatments of research standard. The present volume gives a detailed account of the valence-bond method, the method of molecular orbitals (LCAO approximation), the method of anti-symmetrized molecular orbitals and the free-electron approximation, and applies these to a variety of typical molecules to explain their spectra structure and chemical behaviour. The work can be regarded as a standard text for anyone concerned with quantum chemistry, as well as a useful reference book for workers already in the field.

At the present time it appears that no book in English covers this topic in a comprehensive manner, and it is to be hoped that this volume, which is a translation into German of the original (1959) publication in French, will soon be followed by an English translation. The diagrams are clear, the tables well chosen and for those to whom the language is no barrier it is relatively cheap.

W. C. PRICE

WORLD REVIEW OF NUTRITION AND DIETETICS. VOLUME II. Edited by G. H. Bourne. Pp. viii + 247. *London: Pitman Medical Publishing Co. Ltd,* 1960. 60*s*.

The first of this new series of annuals was published just about one year ago (though incorrectly given in *J.*, 1960, 357 as published in 1960, instead of 1959); in reviewing it, I gave reasons for thinking that it had 'come to stay.' Having now achieved a birthday, *World Review* looks to be well on the way to fulfilling my prophecy.

In scope and aim this second volume does not depart from the high standard set by Professor Bourne and his assistant editor, Dr Eileen M. H. Wilson, presumably also of Emory University, though she remains unlocated on the title page. Contributors come from seven different countries; only four of them are English-speaking, but the articles by experts from France (of whom there are two), Sweden and Switzerland are all written in, or have been translated into, English.

Professor Bourne's aim, expressed and achieved, has been to provide critical surveys by authors who are experts, but who may differ in their views from other, and perhaps even most, of the experts in the same field. Doubtless that is one reason why Professor Gordonoff, with Professor Minder, of Bern, was invited to contribute on the subject of fluorine the highly contested view that this element is essentially toxic—apart from being an 'iodine-inhibitor' and therefore possibly an active goitrogen—and should therefore in no circumstances be added 'to drinking water, which makes impossible any kind of exact dosage and control.' Perhaps Professor Fred J. Stare will be invited to state the case for fluoridization in next year's *World Review*.

Dr D. S. McClaren's article about malnutritional effects on the eye, especially in experimental animals—they would more specifically have been described as laboratory animals, since they seem to be confined to rats, chicks, rabbits, guinea pigs and salamanders—successfully tackles the task of surveying synoptically (doubtless the right word here) a variety of experimental findings and co-ordinating them with the clinical findings considered in the first six pages. There are some admirable reproductions (black and white only) of photographs illustrating certain effects of protein deficiency on the histology of the rat and the pig eye.

Other articles in this interesting issue cover the relationship between protein intake and blood formation; that between diet and the secretions of the adrenocortex; the microbiology of digestion, with special emphasis on, but not in any way confined to, ruminant digestion; and certain aspects of the biochemistry and nutritional roles of the vitamins A (including carotene), C and D. A highly apposite article on calcium metabolism in relation to the parathyroid shows that Professor Bourne remains on the *qui vive* for the topical, for, as the author of the article observes, 'We are now entering a phase of parathyroid research which compares almost in importance to that opened by Collip (1925) and by Greenwald and Gross (1925).'

The appearance, including make-up, typography and binding, of this volume maintains the excellent standards set by its predecessor. There are, however, two minor matters in which more up-to-date procedures might be used. First, there seems to me to be no longer any justification whatever for spelling the unit of metric weight with a terminal 'me'; this may be retained in such pseudo-mausoleums—and a mausoleum is a dignified and indeed often impressive structure—as the various national Pharmacopoeias, but surely not in contemporary scientific handbooks or reviews: the word is, now, 'gram.' Secondly, what on earth is the value of using the same 'running head' for both left-hand and right-hand pages? Surely one of them, preferably the left-hand one, could better bear the name of the whole volume, or better still that of the author or authors of the article whose short title would continue to appear on the right-hand one. Perhaps the editor will consider these two changes when he is preparing, as I hope and do not doubt he now is, the third volume of this new and already welcome series.

A. L. BACHARACH

DIGESTIVE PHYSIOLOGY AND NUTRITION OF THE RUMINANT. Proceedings of the University of Nottingham Seventh Easter School in Agricultural Science, 1960. Edited by D. Lewis. Pp. ix + 297. *London: Butterworths,* 1961. 50*s*.

The welfare of mankind depends much more than is commonly realized on the ability of ruminants to convert grass and other coarse fodders into meat, milk and wool, and during the past 20 years knowledge of the complicated digestive processes which enable these animals to to do this and how these processes work has increased with great rapidity. The subject was dealt with in a most comprehensive way at the Seventh Easter School held in the Department of Agricultural Sciences of the University of Nottingham in 1960. The papers read at that Conference and summaries of the discussions that followed them are published in this book. The 23 papers are classified under three headings: the physiology of the rumen; the metabolism of the rumen; and ruminant nutrition and endocrinology. Each paper concludes with a list of references, and the book ends with a list of those who attended the School, and author and subject indexes.

The papers have all been written by research workers who have themselves made important contributions to the advancement of their particular aspect of the subject. Most of the authors are engaged in research work in Britain, but there are papers also by such well-known authorities as S. Hyden of Sweden, R. W. Dougherty of New York, E. Brouwer of Holland and J. C. Shaw, formerly of Maryland and now with F.A.O. in Rome.

It would be invidious to select any paper for special praise or criticism, since they all attain a high standard and efficiently achieve their main object of presenting a clear and concise account of our present state of knowledge of ruminant digestion and metabolism.

Dr Lewis is to be heartily congratulated on doing such a great service in organizing this Easter School, and in editing its proceedings with such care and efficiency. The book is excellently produced and printed, and can be thoroughly recommended not only to research workers but to all whose duty it is to teach or learn ruminant biochemistry and physiology.

J. A. B. SMITH

XVIITH INTERNATIONAL CONGRESS OF PURE AND APPLIED CHEMISTRY. VOLUME II. BIOCHEMISTRY AND APPLIED CHEMISTRY. Pp. 426. *London: Butterworths; Weinheim: Verlag Chemie GmbH*, 1960. 75*s*.

This volume contains the Plenary Lectures given at the Seventeenth International Congress of Pure and Applied Chemistry in Munich, September, 1959, some in English, others in German or French. The general subjects covered include aspects of natural pigments and their biosynthesis; structure, biogenesis and synthesis of biologically important oligopeptides; reactions at ultra-high pressures; disposal and utilization of biogenic and industrial wastes; and food additives and pesticide residues in food. The coverage of each field is, of course, incomplete, but the individual reviews of the detailed subjects are very authoritative and up to date, as would be expected from the list of illustrious names to be found on them. The articles are moreover not *just* reviews, but critical and balanced assessments containing much original thought and a good deal of experimental work not published at that time, although some has since appeared in print. While written authoritatively and without too many concessions, the lectures were nevertheless intended to be understood by people with only a general interest in the field discussed. The expert will therefore find much that is new, and the more general reader a series of reviews which are broad in outline and usually not too difficult. The book, as a book, is a pleasure to handle.

A. J. BIRCH

SYNTHESIS AND ORGANISATION IN THE BACTERIAL CELL. (CIBA Lectures in Microbial Biochemistry.) E. F. Gale. Pp. vii + 110. *New York: John Wiley & Sons Inc; London: Chapman & Hall Ltd*, 1959. 28*s*.

This book is based on three Ciba Lectures delivered by the author at the Institute of Microbiology, Rutgers, in 1959. Consequently, no attempt has been made to present a comprehensive account of general biosynthesis in bacteria, and the book deals specifically with structural organization in the bacterial cell and its significance in the processes of macromolecular synthesis.

The first chapter deals with the visible or demonstrable structures in bacteria. The treatment is largely chemical, and such structures as walls, membranes and cytoplasmic particles are described in terms of their chemical composition with somewhat less emphasis on their appearance. Evidence for active transport across cell membranes is discussed, and the effect of penicillin on wall formation is described. The structural differences which distinguish bacterial cells from those of animals and plants are illustrated, and it is pointed out that these differences, particularly in relation to the nucleus and cytoplasm, may well result in differences in the sequence and nature of events in nucleic acid and protein synthesis. The specificity of antibiotics in interfering with such fundamental processes as protein biosynthesis may be related to differences in the mechanism of macromolecular biosynthesis in animals and bacteria.

The complex and still incompletely understood problem of amino-acid incorporation is discussed in the second chapter. Important contributions in this field have been made by the author, and details of this and related work are well presented. This subject, and that of the mechanism of nucleic acid and protein synthesis discussed in the final chapter, has advanced rapidly during the two years which have elapsed since the lectures were delivered; thus some of the problems discussed are now rather better understood.

The book contains much interesting material and should be read by all interested in macromolecular biosynthesis. It is not an elementary treatment, and is more suitable for advanced students and research workers than for beginners.

J. BADDILEY

FEARON'S INTRODUCTION TO BIOCHEMISTRY. Fourth Edition. Edited by W. J. E. Jessop. Pp. vi + 473. *London: William Heinemann Medical Books Ltd*, 1961. 30*s*.

When Robert Fearon died late in 1959 this fourth edition of his well-known book was still partly in manuscript, and the text has been finished and edited by his friend and colleague, Professor Jessop. First appearing in 1934, this rather unique textbook of biochemistry has been almost entirely rewritten for the present edition. The text is divided into two sections dealing respectively with the 'constitutive' and 'dynamic' aspects of biochemistry, and includes two useful appendixes on the composition of foods and the preparation of reagents. Among new sections added are those on enzymes and enzyme kinetics, hormones, protein structure and metabolism, carbohydrate metabolism, cellular respiration and the chemistry of tissues. This has been achieved without lengthening the book by a drastic reduction of the practical procedures given in earlier editions.

In many respects this is an unusual textbook and bears the firm impression of Fearon's personality and

diversity of interests. This is seen in his lapse into philosophy and 'vitalism' in the first chapter, his choice of uncommon though often more exact terminology (carbon monoxyhaemoglobin) and the numerous quotations (from Psalms to G.B.S.) which, though sometimes apt, tend to become tedious.

The inclusion of relevant topics of physical and inorganic chemistry in the first few chapters is excellent, since this information is usually sorely required by students using this text. Even so, more space could have been given to these topics, in particular to electrolyte balance. In most respects the text is up to date, but in such a recent publication one would expect to find, for example, more data on steroid and fatty-acid biosynthesis, ubiquinones and oxidative phosphorylation.

The major fault with this publication is a common one with British textbooks of chemistry, namely bad printing of chemical formulae. The worst examples in this volume are to be found in the formulae of steroids and other cyclic compounds. Some figures, such as that for DPN, are so distorted that they could lead students into error.

The simplicity, clarity and conciseness of the text, together with the reasonable price, will ensure renewed popularity for this well-established book, particularly with medical students.

D. V. PARKE

PROTIDES OF THE BIOLOGICAL FLUIDS. Proceedings of the Eighth Colloquium, Bruges, 1960. Edited by H. Peeters. Pp. x + 356. *Amsterdam: Elsevier Publishing Co.; London: D. Van Nostrand Co. Ltd*, 1961. 86*s*.

This volume, the report on the eighth of the Bruges Colloquia, is largely devoted to methods of separation and identification of individual serum proteins, though scattered through the volume are brief notes on such diverse subjects as protein losses following gastrectomy, the metabolism of gamma globulin and the fluctuations of the C-reactive protein in burns.

The monograph opens with a series of short papers on the properties of fibres and gels, with special reference to the effects that their physico-chemical behaviour may have on the separation of materials absorbed through their surfaces.

The next section is headed 'New Techniques'. This appears to be something of a misnomer, for although there are some excellent articles, such as that by Nyns and Lontie on zone electrophoresis at very low ionic strength, and one on the applications of ultrafiltration to protein solutions by Albert-Recht and Stewart, no new techniques are, in fact, described. The last article in this section concerns observations on the intracellular albumin in the rat liver, contributed by Gordon and Humphrey. This appears to be somewhat out of place as it is an account of some preliminary experimental work, which it is hoped will be extended and amplified by the authors in due course.

Section B is devoted to biological studies employing the well-established technique of immuno-electrophoresis. In passing, it is odd to notice that whereas the authors have given sectional indexes for Sections A, C and D, they seem to have neglected to do so for Section B. Dr Burtin opens this section with a note on the antigenic structure of human γ-globulin. This article appears to be a fragment from some more extensive research project, and it is unfortunate that the author has thought fit to give this rather dated work and leave us to guess or search in other periodicals for other papers that must have flowed from it. In this section there is a useful note on immuno-electrophoresis in relation to autoradiography by Clausen and Munkner.

Sections C and D are devoted in the main to the characterization and the behaviour of isolated families of serum proteins, such as the glycoproteins and transferrins, and an assortment of short papers dealing with specific and relatively unrelated aspects of the dysproteinaemias. Among these are two attractive studies presented by Cohen and Freeman on the metabolism of human γ-globulin and the serum proteins in the nephrotic syndrome. There is, however, little that has not been published elsewhere.

It does not appear that the articles in this monograph have been through any sort of intellectual sieve, if one can judge by the wide diversity of quality. This is not to say that a reader especially interested in the field may not find much of interest. The Colloquia have now become so popular that it is possible that the very volume of the contributions has resulted in the appearance of a lack of cohesion.

N. H. MARTIN

BIOLOGICAL DEGRADATION OF CELLULOSE. J. A. Gascoigne and M. M. Gascoigne. Pp. vi + 264. *London: Butterworths*, 1960. 42*s*.

This book deals with an aspect of the technology and biochemistry of cellulose to which little attention has been paid in detail until comparatively recently. The earlier contributors on the microbial decomposition of cellulose, such as Thaysen and Bunker, Winogradsky, Galloway and Siu, brought the subject into perspective and underlined its economic importance. But, in the main, they looked at it from the causal micro-organism point of view.

The present authors take the modern and fundamental approach by dealing with the enzymic hydrolysis of cellulose and related β-glucosides, and with the occurrence and isolation of the enzymes which are involved. This the authors rightly describe as a major field of enzymic action that has only recently been studied in detail. They emphasize the enormity of the annual loss in wood products and textiles due to the microbial decomposition of cellulose, and they stress the fact that only empirical methods are used on a lavish scale to counter this natural destruction of cellulose.

The title can give a narrower impression than the subject matter in fact deserves. After a concise review of the chemistry and physics of cellulose itself, and its naturally associated polysaccharide relations, the book expands on the enzyme actions and the enzymes concerned in the degradation of these compounds. The authors are at this point on their home ground. A warning is carefully sounded that all classes of enzymes are often present during the microbial degradation of polysaccharide material and that initial, secondary and higher orders of decomposition are confused. But evidence is carefully presented for the view that hydrolysis is the first stage of the enzymic degradation of cellulose.

Additionally, this book performs the useful and important service of giving information to those in other fields by touching on related subjects such as microbial symbiosis, the prevention of enzyme action by toxic and physical barriers, digestion in ruminants and enzyme action in cereals. It is always a pleasure to read a book which does not scorn to mention and to link together apparently widely differing aspects of technology.

There is little to fault in the text. It is rather unfortunate that the ill-defined and arguable term D.P. (degree of polymerization) should feature so prominently, but this is understandable as coming chiefly from North American sources. The excessive use of molecular formulae and capital abbreviations instead of proper names in tables and in text is quite irritating in places. This is a criticism less of the present authors than of the regrettable form of shorthand which has blossomed in medical biochemistry papers.

Tables, graphs, structural and algebraic formulae have all been well set out and printed. A great deal of information has been collected and compiled into one book which the reader, whether new to the field or experienced in it, will find most useful in content and in view-point.

W. F. KIRKPATRICK

STANDARD METHODS OF CLINICAL CHEMISTRY. VOLUME III. The American Association of Clinical Chemists. Editor-in-Chief D. Seligson. Pp. x + 230. *New York: Academic Press; London: Academic Books Ltd*, 1961. 52*s*.

This volume follows the pattern of the two previous ones, and reaches the same high standard. Methods for the determination of various toxic agents, enzymes, hormones and other constituents of biological fluids are described.

The methods are based on those already published, with modifications in some cases, and are clearly and fully set out. The comments of the independent checkers in several instances provide a valuable addition to the contributors' own description.

An interesting chapter is included on the properties of abnormal haemoglobins; it brings together information which is not readily obtainable elsewhere. Two methods for urinary catecholamine estimation are given, one a bio-assay and the other a fluorimetric procedure based on that of Lund. Although in the second of these methods the problems of fluorimetric analysis, with particular reference to interference by quenching in urine eluates and the provision of adequate standards, are emphasized, it is doubtful whether at the present time any fluorimetric or other chemical estimation for these metabolites in urine fairly deserves to be called a standard method. However, in view of the widespread clinical interest in levels of catecholamine excretion, the editors no doubt felt that it was desirable to include a well-tried assay, despite its shortcomings.

The editors do not expect that all these methods will necessarily be adopted for routine use, but hope that those described will prove useful in checking less rigorous routine procedures. It seems that the book will fulfil this function adequately, a function that is becoming increasingly important with the spread of automatic techniques and simplified procedures in clinical laboratories.

DIANA M. CAMPBELL
D. W. MOSS

PROGRESS IN MEDICINAL CHEMISTRY. VOLUME I. Edited by G. P. Ellis and G. B. West. Pp. ix + 262. *London: Butterworths*, 1961. 60*s*.

The intention in this series of survèys is to provide the 'chemist, biochemist, pharmacologist, and to a smaller extent, the clinician' with authoritative accounts of progress in some half-dozen topics of current interest. But potential readers should not be misled by the title. Chemistry is discussed almost exclusively as it concerns structure–activity relationships, the only exception being some brief notes on synthetic methods in the chapter on antifungal agents. The chemist must not therefore expect to find comprehensive lists of preparative references, and in this respect this new publication is complementary to the section on chemotherapy found in the annual *Reports on the Progress of Applied Chemistry*. Instead he will find a mine of information, backed by comprehensive bibliographies, about the pharmacology of individual compounds. In each chapter the nature of the condition to be treated and the methods employed for testing and arranging particular types of drugs are fully described. These must be of great interest to the chemist who is keen to know what happens after the potential new drug has left his hands. General pharmacological screening tests are dealt with in the first chapter, with an analysis of some of the costs involved. These are of dubious value in that they include only the direct labour charges and the cost of the animals. Overhead expenses are ignored (having presumably been provided for by the Local Education Authority), and their magnitude would probably surprise the author were he to attempt to assess them. Nevertheless the

schemes proposed are as wise as could be in their economy.

Further chapters cover hypotensive agents and tranquillizers, with the difficulties of defining the latter exemplified by the inclusion of drugs having sedative action and hypnotic action. The latter article is notable for the section on the chemistry of brain function. Similar interesting accounts are given on kidney function in the chapter on diuretic drugs, and on the pancreas in that dealing with oral hypoglycaemic drugs. There are some errors in the chemical terms used in the latter (*e.g.* synthalin = a diguanide), but these should not confuse the chemist. The final chapter is an excellent account of synthetic and natural antifungal agents.

The printing and lay-out are attractive throughout, and the whole volume is worthy of praise in its conception and execution.

F. L. ROSE

THE HARVEY LECTURES. Series LV. Delivered under the Auspices of the Harvey Society of New York, 1959–1960. Pp. xv + 257. *New York: Academic Press; London: Academic Books Ltd*, 1961. 64*s*.

Three of the eight Harvey lectures of the 1959–60 series are of direct interest to chemists. There is a concise account by Carl Moore of current knowledge of the absorption, transport, storage, utilization and excretion of iron. The evidence against the theory of mucosal block is summarized, and future interest will undoubtedly lie in movements of iron into and out of cells and with its function in the cells. Doty has described the way physical measurements can elucidate the single or double helical structures of nucleic acids and polyribonucleotides such as polyadenylic and polyuridylic acids synthesized by the enzyme polynucleotide phosphorylase. These investigations are helping to establish the nature of the ribonucleic acids responsible for controlling protein synthesis, for the transfer of amino acids to the sites of synthesis and for carrying the genetic code from the deoxyribonucleic acid, the carrier of the code for transporting hereditary information. Berliner's lecture is a valuable contribution to our understanding of the mechanism of potassium secretion. He has shown clearly that potassium excretion results not from incomplete re-absorption of potassium filtered at the kidney glomerolus but from potassium secretion in the renal tubule after there has been complete re-absorption. Secretion depends on exchange for sodium and hydrogen ions, which therefore need to be available when potassium has to be excreted.

H. Rahn discusses the important role in body processes played by nitrogen, hitherto regarded as an inert element. The choice of nitrogen or sulphur hexafluoride for the inflation of a collapsed lung and of oxygen for the maintenance of an artificial pneumothorax has been shown to depend on relative diffusion rates. A striking biological parallel is provided by the waterboatman, the air bubble of which has to be a certain size for adequate exchange of respiratory gases and requires renewal not on account of oxygen uptake but because of loss of volume by diffusion of nitrogen. There is a remarkable circulation of nitrogen in the lung brought about by arterial-alveolar difference due to ventilation–perfusion differences among alveoli. The alveolar nitrogen can be obtained by direct analysis, while it has been shown that the arterial nitrogen concentration is the same as in the urine.

The more biological lectures included one on the quantitation of growth of mammalian cells and an especially interesting account of the biological foundations of wound repair, emphasizing the way like cells aggregate and multiplication of cells stops when they meet other cells. Other lectures were given by von Euler on the role of noradrenalin as the transmitter of the nerve impulse in the sympathetic nervous system, while Jost related the role of foetal hormones before birth. As is usual in this series, there is a wide and interesting variety of topics.

C. H. GRAY

MICROANALYSIS BY THE RING OVEN TECHNIQUE. International Series of Monographs on Analytical Chemistry. Volume I. H. Weisz. Pp. 112. *Oxford: Pergamon Press*, 1961. 30*s*.

This book provides for the first time in English a detailed account of the principles and applications of the ring-oven technique. In the seven years since the technique was first described by Professor Herbert Weisz of the Technische Hochschule in Vienna, it has undergone considerable development at the hands, not only of its inventor, but also of several other chemists who were quick to appreciate the versatility of the ring-oven techniques. It is appropriate that at this stage of development the now quite extensive literature should be brought within one cover, and it is fortunate for us that the author should choose English rather than his native language to present his information.

The text is divided into four main sections dealing in turn with the apparatus and its use, its applications to qualitative analysis and semi-quantitative analysis, and its combination with other techniques. The ring oven itself, designed originally for the separation of ions in a single drop of solution, has changed little since it was first described; despite attempts by others to complicate the equipment, the results are as effective with the original relatively simple piece of apparatus. Certain refinements have been proposed to the apparatus, and new methods of separation with ancillary apparatus have been developed that considerably enlarge the scope of the technique as applied to inorganic microchemical analysis; nevertheless the basic principles remain unaltered.

The section on qualitative analysis covers a wide range of chemical procedures for both separations and

identifications. A large number of tests suitable for the identification of many cations and anions are provided. The section on semi-quantitative analysis includes details of the 'universal standard scale' by which any number of individual ions can be determined with one scale of reference. The versatility of the basic technique is well illustrated in the final sections, which show how techniques such as electrographic analysis, radiochemistry and paper chromatography are easily linked to the ring-oven techniques with very beneficial results.

I have, by lectures and articles, attempted to publicize the potentialities of this simple and elegant technique. This has been in many ways a rewarding task, but still the feeling remains that too few chemists are aware of the ring-oven work. Professor Feigl, in a foreword to this book, considers the development of the ring oven to be an 'important milestone' in microchemical analysis. The publication of this monograph is an equally important event which must stimulate a wider interest in the technique and prove beneficial to its further development. For a modest outlay the chemist has access to a vast new field of microchemical analysis. The possible applications of the technique are so extensive that most branches of chemical science are involved, and few chemists can afford to overlook this monograph.

The clear and succinct way in which Professor Weisz has presented the many facets of this elegant technique contributes to an easy understanding of the subject. And if a final recommendation is necessary, the book is well printed and attractively bound.

WILLIAM I. STEPHEN

SEMI-MICRO QUALITATIVE INORGANIC ANALYSIS. For G.C.E. Advanced and Scholarship Levels and Ordinary National Certificate. R. E. Dabby. Pp. 47. *London: University of London Press Ltd*, 1961. 4*s*. 6*d*.

The increasing use and popularity of semi-micro methods in inorganic qualitative analysis in the last few years has stimulated the writing of a number of small books on the subject. All follow the classical method of analysis and describe, with minor modifications, the generally accepted techniques; all are aimed at satisfying the needs of the secondary grammar and technical schools; all can be criticized on odd points of technique or chemical procedure. The book under review is no exception.

Chapter I, dealing with apparatus and technique, recommends a rather lavish set of apparatus, containing both test-tubes and centrifuge tubes, when either would suffice. The author deplores the normal technique of washing pipettes from a beaker of distilled water, and prefers that each student be supplied with four droppers and four gas delivery tubes—most teachers would consider this provision an extravagant one since the normal procedure, when correctly taught and supervised, demands only one of each of these items.

The author recommends using a 50 mg sample dissolved in 1 ml as the solution for the systematic scheme of examination for the cations (chapter V). This gives a 5 per cent solution of the substance which, on average, for a four-radical mixture would give cation concentrations of over 1 per cent—far too high for efficient and clean separations.

The scheme of analysis is, in the main, sound and follows traditional lines, but it is very doubtful if the test for magnesium with magneson will function as described on p. 36. In the explanatory notes, the author quite correctly describes the behaviour of this reagent but fails to mention that the ammonium salts must be removed before applying it.

The chief merit of this book is its attractive price. There are several printers' errors which need attention, the most persistent being NHO_3 (pp. 25, 29, 32, 34).

H. HOLNESS

SMALL SCALE CHEMISTRY. For Ordinary Level. P. J. Hills. Pp. 128. *London: Edward Arnold (Publishers) Ltd*, 1961. 7*s*. 6*d*.

The chief feature of this book is the recommended use of small-scale techniques by students preparing for the 'O' level examination of the General Certificate of Education. Two introductory chapters are used to describe the basic ideas, and are followed by the more usual topics under conventional headings. The special glassware used for this course can be made from standard apparatus of low price.

As might be expected for a book of this type, the presentation of theoretical ideas has been kept to a minimum. However, the wording of some of the definitions given could be improved to ensure better guidance for examination candidates (*e.g.* solubility as defined on p. 44). A few of the statements given do not agree with experience (*e.g.* p. 84, test 3 : the formation of hydrogen from 1 : 1 nitric acid and magnesium).

After reading about a number of novel techniques for use at this elementary level, it was disappointing to find only scaled-down versions of standard school experiments described in the main body of the text. No doubt the deficiencies of certain gas preparations are revealed only when the experimenter goes beyond the prescribed tests. It was noted that the use of a filter pump is required for two experiments (p. 25 and p. 31), although no reference is made to the possible use of filtration under reduced pressure. The author advises the use of small-scale simple filtration and prefers not to use a centrifuge for work below sixth-form level. A number of the tests given are incompletely described (*e.g.* p. 40 : both gas samples formed in test 4 light 'with a pop'; p. 43 : the test given for solubility is incomplete; p. 53 : no reference is made to the reaction of alkalis with

ammonium salts; p. 68: the influence of iodine concentration on the colour changes quoted in test 4 are not stated).

It was pleasing to read a scheme that permits most of the experimental work for 'O' level to be carried out by the student with a minimum risk of accidents and at relatively low cost. The book is well illustrated and has an index. It is intended to be used in conjunction with an ordinary textbook.

B. E. DAWSON

INORGANIC CHEMISTRY. AN INTERMEDIATE TEXT. Pp. viii + 393. PHYSICAL CHEMISTRY. AN INTERMEDIATE TEXT. Pp. viii + 322. ORGANIC CHEMISTRY. AN INTRODUCTORY TEXT. Pp. xxii + 321. C. W. Wood and A. K. Holliday. *London: Butterworth Publications*, 1960. 21*s*. each volume.

These three books were written to cover the needs of chemistry students for the General Certificate of Education 'A' and 'S' level examinations, and the authors also believe them to be of value to first-year university students and to H.N.C. and Grad.R.I.C. students in technical colleges. The authors' aim has been achieved, for, assuming their readers have a knowledge of 'O' level chemistry, they may tread with confidence well-graded pathways in all three branches of chemistry leading to their next academic hurdles.

Several important characteristics of this triology deserve special mention and commendation. The authors realize the unity of chemistry and the artificial subdivision that calls for separate courses and examinations, and therefore for separate textbooks on each branch of chemistry. The volumes may be used independently, but under wise teachers will without doubt be used together in schools. The value of showing the historical development of chemistry has been recognized, and important stages in the presentation of many topics have been treated in this way.

Modern developments have not been neglected. For example, there are brief and superficial treatments of very advanced topics not commonly considered to be within a school syllabus although appropriate to university and technical college study. In this category are the discussion of wave mechanics applied to structure and reactivity of organic compounds, an account of the determination of structure by various spectroscopic means (nuclear magnetic resonance spectroscopy is covered in one paragraph), and the compression into 20 pages of the discussion of atomic structure, radioactivity, nuclear structure, fission, and the production and use of radioisotopes. The more usual topics in physical, inorganic and organic chemistry are treated systematically, and full use is made of unifying principles, such as the periodic classification, valency theory (supported by important physical concepts such as bond lengths, angles and ionic radii) and properties of functional groups of atoms.

The authors' style is easy, and the production and binding modern and attractive. A. J. LINDSEY

NATURAL GAS AND METHANE SOURCES. J. Lawrie. Pp. xiv + 204. *London: Chapman and Hall Ltd*, 1961. 35*s*.

In recent years there has been technological development in the usage of methane. This has arisen primarily through the discovery of new supplies, but not, unfortunately, in the United Kingdom. There are problems involved in the transportation of this fuel, but these are being overcome. This book presents a descriptive account of the new technologies involved in transportation of liquid and gaseous methane and its chemical usage. That the information provided is up to date can be seen from literature references dating from the late 1950s.

After a brief chapter on the properties of methane, accounts are given of its occurrence in coal mines and gas deposits. There are chapters on industrial methane fermentation, liquefaction, storage and analysis, including infra-red and chromatographic methods. The final quarter of the book is devoted to industrial usage. Methods of reforming before use as town's gas are discussed, followed by an account of methane as a fuel for internal combustion engines. Probably the most important chapter deals with the production of chemicals from methane. A raw material which can be used for the manufacture of carbon black, hydrogen, ammonia and acetylene is clearly of considerable value, and it is fitting that technical discussion pertaining to these transformations be given reasonable coverage. Finally, accounts are given of the possible use of methane in fuel cells, the separation of helium from natural gas and the use of radioactive tracers for discovery and assessment.

The author has succeeded in giving a descriptive account of recent methane technologies. There are a number of misprints, and a rearrangement of the facts in some places would have enhanced the value of the book. For example, properties of methane are given in chapter 1 and repeated at somewhat greater length in the chapter on chemical usage. The steam–methane reaction is discussed twice for no apparent reason; and it would have been better to stick to the same units of calorific value throughout. D. B. SCULLY

INTRODUCTION TO PETROLEUM CHEMICALS. Edited by H. Steiner. Pp. x + 200. *Oxford: Pergamon Press*, 1961. 50*s*.

A series of lectures by specialists in various branches of the petroleum chemical industry, given at the Manchester College of Science and Technology during the autumn and winter of 1959, is collected in this volume. As Dr Steiner himself states in the preface, such a collection suffers from the disadvantage of differences in

approach, technique of presentation and depth of treatment; this is exemplified by comparing the 12 pages of J. W. Woolcock's lecture on 'Cracking Processes for Olefins,' with which the series starts, with the 32 pages of B. Thorley's lecture on 'Carbon Black,' which ends the volume.

The second lecture is contributed by M. Ruhemann, who gives a comprehensive and succinct account of 'Separation Processes for Olefins.' This is followed by papers from F. E. Salt and R. N. Howard, who deal with 'Products from Ethylene and Propylene' and 'Polymers of Ethylene and Propylene,' respectively. The lecture by E. B. Evans on 'The Production and Use of Butadiene and Isobutylene' surveys the separation and reactions of the butanes, butenes and butadiene as well as their usage in production of alkylates, alcohols and polymers. J. L. Edgar's paper is on 'Aromatics from Petroleum,' and summarizes catalytic reforming, hydroforming, platforming, the Catarole process and the various methods of separating individual aromatics and their derivatives. The paper by S. H. Dawson on 'Styrene and Polystyrene' follows naturally after this. The contribution on 'Acetylene from Hydrocarbons' by J. W. Haworth and W. J. Grant summarizes not only the production and separation methods but lists both operating and pilot plants. Factors influencing choice of process are discussed, and a very full list of references given.

To those possessing a knowledge of chemistry this collection furnishes an interesting general survey of a number of the principal petroleum chemical processes, including considerable statistical information. Readers with some experience of the industry will have different views on the amount of space devoted to the various topics, but as an introduction to the subject this book can be confidently recommended. It is well produced with an adequate index, although by chance it was noticed that the reference to propadiene occurs on p. 26 and not p. 13.

L. A. WILSHERE

PAINT TECHNOLOGY MANUALS. PART I. NON-CONVERTIBLE COATINGS. Oil and Colour Chemists' Association. Pp. 326. *London: Chapman & Hall Ltd*, 1961. 30*s*.

'Non-convertible' coatings are those paints and varnishes that harden not by chemical reaction but by evaporation of solvent or dispersion medium or by cooling from the melt. Older books on varnish manufacture would have covered this class of materials under the title 'Spirit Varnishes', coatings prepared from natural gums and resins and a volatile solvent. In the present work, spirit varnishes are treated in the last chapter. Their displacement has come about by the arrival of the great variety of synthetic film-forming media.

The present work, a composite one by 11 contributors, is the first of six manuals intended to cover the whole field of paint technology. Their primary purpose is to provide all necessary material for students taking the City and Guilds examinations in the subject. Appropriately enough, the book opens with a chapter on nitrocellulose, the semi-synthetic medium which arrived in the 1920s as a competitor to the drying-oil finishes. Manufacture and properties are dealt with and, as with all chapters, very useful practical experiments are included. However, in using the falling-sphere viscometer to measure the viscosity of a nitrocellulose solution it is surely best to teach the student that the method gives a direct measurement of viscosity, instead of advising the use of a liquid of known viscosity to calibrate. Further chapters cover the other consituents of a nitrocellulose paint or varnish, namely solvents, co-solvents, diluents, plasticizers, resins and pigments. A highly technological chapter on wood finishes illustrates the different approach of the various contributors. The student is here introduced to the apparent vagaries of formulation, an art in itself in which the chemist achieves many desirable properties in his final product at not too excessive cost. The attempts to put rubber to work in the paint field by chlorinating, isomerizing, oxidizing or depolymerizing the rubber molecule are well described. A notable chapter, well written by its three contributors, covers the synthetic thermoplastic resins. Mention is made of the new organosol and plastisol techniques, in which a viscosity sufficiently low for application is obtained by dispersing rather than dissolving the resin. A continuous film is obtained by subsequent heating and fusing of the resin particles.

A good balance between technology and pure science is never easy to obtain. In the present work the abundance of contributors has meant that this balance is well realized, and so it provides a manual of great use to the student and of certain interest to all paint chemists.

A. S. FREEBORN

A SOCIAL HISTORY OF ENGINEERING. (Technology Today and Tomorrow Series.) W. H. G. Armytage. Pp. 378. *London: Faber & Faber*, 1961. 42*s*.

Historians in the nineteenth century were much preoccupied with the constitutional and military aspects of their subject. Not until comparatively recently did the importance of other factors, such as economic and social ones, begin to be recognized. More recently still, the historical significance of technological innovations has begun to be recognized. To disentangle any one of these historical threads is difficult enough; the task becomes far harder when an attempt is made to trace the relationship between them. It is disappointing, but not altogether surprising, that this book fails to live up to its title. As a history of engineering it is a useful addition to the literature, but the author never really gets to grips with one of his main aims, namely to indicate how technological developments 'have affected and been

affected by social life at certain stages and to offer some clues as to the origins of innovations and institutions'. The main reason seems to be not that the author has not adequately pondered these topics—for it is clear that he has read very widely—but that he has so loaded the text with detail that he simply has not left himself space to do justice to social factors. The final chapter, which attempts some generalization and prediction of some of the future consequences of technological development, is something of an anticlimax.

When a single author seeks to cover so vast a space of time and so wide a range of topics it is inevitable that he has not a uniformly firm grip of his subject. Chemists need not, therefore, be greatly surprised to find some unexpected statements. Thus in relation to the Solvay process we are told that 'eventually the increased production of ammonia made the Ammonia-soda process economically sound'. On the same page we are told that Brunner and Mond established their works at Willington. Of Alfred Mond we are told only that he 'entered the House of Commons in 1906 and bought the *New English Review*. This took up John Masefield'. In the same section Rothamsted is described as the source of 'a steady stream of information as to the growth of cattle'; while it is, of course, true that experiments on animal nutrition were an important part of the work at Rothamsted, most people would first think of it in the context of plant growth. Elsewhere, there are some curious turns of phrase: it is a little puzzling to be told that 'Gurney's steam carriage weighed no more than a 15-cwt. truck does today'. However, in remarking on such points of detail it must in fairness be pointed out that the book is crammed with a wealth of information which is in the main perfectly sound, much of it not commonly known.

In brief, this is a fair history of engineering but a not so good social history of engineering. In attempting an ambitious picture the author has paid too much attention to detail and neglected the broad sweep.

TREVOR I. WILLIAMS

SCIENCE IN INDUSTRY. POLICY FOR PROGRESS. C. F. Carter and B. R. Williams. Pp. ix + 186. *London: Oxford University Press*, 1959. 21*s*.

This book is concerned with proposals for promoting a fuller use of science in industry. The authors are both professors of economics and this is their third report on behalf of the Science and Industry Committee of the British Association for the Advancement of Science.

The book is divided into two parts, the first part devoted to action open to industry itself and the second part to action open to the Government. In Part I the authors stress that science alone will not ensure the progressiveness of a firm: science, in the form of research and development, is but one of a group of related management techniques which have as objective the enhancement of the firm's effectiveness.

Attention is directed to the problems confronting firms which are anxious to innovate. Many such firms could be technically progressive without undertaking research and development themselves if they were only aware of scientific developments elsewhere. They are handicapped by the inadequacy of the lines of communication of scientific ideas to management. The lack of a scientist within the firm is frequently the missing link in the chain, but the authors also make other proposals for facilitating communication. But though firms can derive great benefit from the application of existing knowledge, a stage is reached when either research or development, or both, have to be carried out. As it is in the larger firms that this stage is most frequently reached, the problems of innovation in such firms are considered first, but the general principles suggested are relevant for firms of any size. The aspects of innovation discussed range over the decision to embark on research, its day-to-day management and the decision to terminate apparently unfruitful research work. Smaller firms are naturally hesitant about research, and Professors Carter and Williams suggest how such firms can make a start on a modest scale appropriate to their needs, paying particular attention to the need to minimize 'research risk' by means other than costly diversification.

In Part II the authors discuss the action the Government can take to encourage research and development, such as financial assistance to research associations, appropriate taxation and credit policies in relation to research expenditure and the fostering of scientific education.

This is an interesting book and will be of considerable value to the management of all firms contemplating research and those with misgivings about the orientation and ultimate profitability of their research efforts. This value derives not so much from any originality of treatment but because it directs attention to the questions which have to be answered by firms and because of its well-reasoned appraisal of the problems involved.

C. J. THOMAS

PUBLICATIONS RECEIVED

REVIEW OF THE NATIONAL RESEARCH COUNCIL, 1960. Pp. 354. *Ottawa: Roger Duhamel, Queen's Printer and Controller of Stationery*, 1961. 75 cents.

ATOMIC ENERGY LEVELS IN CRYSTALS. J. L. Prather. National Bureau of Standards Monograph 19. Pp. 84. *Washington: U.S. Government Printing Office*, 1961. 60 cents.

MEASUREMENT OF ABSORBED DOSE OF NEUTRONS, AND OF MIXTURES OF NEUTRONS AND GAMMA RAYS. National Bureau of Standards Handbook 75. Pp. 86. *Washington: U.S. Government Printing Office*, 1961. 35 cents.

Institute Affairs

DIPLOMA EXAMINATIONS

Examinations for Postgraduate Diplomas in Applied Chemistry will be held in the autumn in London or elsewhere at the discretion of the Council. The examination in Branch E will be held in the week beginning **Monday, 9 October, 1961**. The dates of the examinations in other branches have not yet been confirmed, but will be at about the same time. Candidates for these examinations should return completed application forms to the Institute not later than **Friday, 11 August.** The last date for the receipt of Entry Forms is **Friday, 1 September.**

BEILBY MEDAL AND PRIZE, 1961

As announced in *J.*, 224, the Administrators of the Sir George Beilby Memorial Fund, representing the Royal Institute of Chemistry, the Society of Chemical Industry and the Institute of Metals, have decided to make awards from the Fund in 1961—each consisting of the newly instituted gold medal with a prize of 100 guineas—to CONSTANTIN EDELEANU, M.A., PH.D., and Professor JACK NUTTING, M.A., B.SC., PH.D., F.I.M.

CONSTANTIN EDELEANU was born in Rumania, and came to Britain in 1937. He was a pupil at the Morrison Academy, Crieff, and then went up to Cambridge in 1941. After a brief period in the Army he returned to Cambridge in 1945 and read Part II Chemistry. In 1946 he joined Dr U. R. Evans, working on the stress corrosion of light alloys. In the course of that work he became interested in pitting reactions and developed the autocatalytic mechanism for pitting first proposed by Dr Hoar. A somewhat surprising conclusion of the work was that the true rate of corrosion during the pitting of aluminium in a given solution was a constant. Direct experimental proof for this was, however, obtained only some 10 years later.

In 1950, he joined the Brown Firth Research Laboratories, where he was in charge of a section dealing with long-term alloy development. Stress corrosion, especially in high-pressure water systems and nuclear-reactor cooling systems, was of particular interest, and the work demonstrated that failures in such systems were, as a rule, associated with concentration effects arising either during heat transfer or in heating and cooling cycles.

His contribution to the development of corrosion-resistant steels was two-fold. Firstly, it was shown that a detailed knowledge of the structure of alloys was necessary in order to make progress and, secondly, the work helped to establish the potentiostat techniques for corrosion studies. This work also showed that the potentiostat was a powerful metallographic tool but, perhaps more important, it showed that it was possible to stabilize passivity to a remarkable extent by 'anodic protection' and that this could form a basis for a practical method of protection in chemical plant. The process is now being used on a fairly large scale in the United States.

In 1956 he joined the Tube Investments Research Laboratory at Hinxton, to form a corrosion group. At first the work consisted mainly of studying the factors that control corrosion in some fused-salt systems of interest to the nuclear-engineering industry. One of the main results was to show that such systems could be treated in a somewhat analogous way to aqueous systems but that there were important differences. For instance, it was not possible to neglect solid-state diffusion and also the vapour pressures of some of the compounds had to be considered. Graphical methods of representing fused electrolyte – metal systems were developed, and this approach is now being used to see whether it might also elucidate certain problems in extraction metallurgy.

More recently Dr Edeleanu has returned to stress corrosion and, in conjunction with Dr A. J. Forty, has attempted to interpret this type of failure in a more physical manner. This led naturally to the question of the part played by dislocations and other such structural features in corrosion. With G. A. Bassett a start was made in this field, techniques such as transmission electron microscopy having played a useful part.

Recent electrochemical studies have included work on passivity, with particular reference to anodic protection. The main result has been the realization that it is possible to design a completely safe anodic protection system even for complicated plant containing, for instance, long lengths of piping.

JACK NUTTING was educated at Mirfield Grammar School, Yorkshire, and the University of Leeds where he graduated with First Class Honours in Metallurgy in 1945. He was then appointed research assistant to the late Professor Preece at Leeds and was awarded the degree of Ph.D. in 1948 for a dissertation on the Overheating and Burning of Steel. Subsequently he was employed by the British Iron and Steel Research Association and was seconded to the Cavendish Laboratory, Cambridge, where he worked with Dr V. E. Cosslett and Professor E. Orowan, developing techniques for the examination of metals with the electron microscope. In 1949 he was appointed demonstrator and in 1954 lecturer in the Department of Metallurgy, the University of Cambridge—an appointment he held until 1960 when he returned to the University of Leeds as Professor of Metallurgy in the Houldsworth School of Applied Science.

During his work at the Cavendish Laboratory he became convinced that the electron microscope could be more widely applied to problems in metallography.

On transferring to the Metallurgy Department in Cambridge he had the opportunity of testing his convictions, and together with a group of research students a wide variety of metallographic problems were investigated. The first topic to be studied was the microstructural changes occurring during the tempering of plain carbon steels. With the development of improved replica techniques, the work on tempering was extended to alloy steels; in particular the phenomenon of secondary hardening in ferritic steels was investigated, whilst attempts were made to correlate the microstructure of these steels with their creep behaviour. The techniques developed for ferritic steels have been modified subsequently for application to austenitic steels, and again the results obtained have been correlated with creep behaviour.

The carbon-extraction replica methods, which had proved successful for studying steels, were completely unsatisfactory when applied to aluminium alloys. In order to examine these materials entirely new specimen preparation methods, thin foil techniques, were developed so that a metal could be examined directly by transmission in the electron microscope. With these techniques it has been possible to detect Preston–Guinier Zones in a variety of aluminium alloys and also to detect coherency strain fields around precipitated phases. Further modifications of the thin foil technique allowed specimens to be prepared from bulk samples, and it became possible to study phase transformations involving shear. The martensite reaction in plain carbon and alloy steels was examined, and the plate-like form of martensite, previously thought to be homogeneous, was found to be composed of a stack of fine twins.

Investigations on the way two-phase alloys deformed plastically were begun with the aid of replica techniques, but when other workers showed that dislocations and dislocation interactions could be studied by examining thin foils in the electron microscope it became possible to determine directly the interactions between dislocations and precipitates. This type of investigation is now being extended to the study of precipitate dislocation interactions during creep.

During the past few years Professor Nutting has visited the United States a number of times, and on the last occasion he lectured at the A.S.M. Seminar on Hardening Mechanisms in Metals. He has lectured also in many European countries on metallurgical applications of the electron microscope. He is a member of the Metal Physics Committee of the Institute of Metals and an Honorary Member of Council of the Iron and Steel Institute.

HENDERSON MEMORIAL LECTURE

The Fourth Henderson Memorial Lecture, organized by the Council in consultation with the Glasgow and West of Scotland Section, was delivered by Dr J. W. Cook, F.R.S., Vice-Chancellor of the University of Exeter, on 12 May in the University of Glasgow. Professor P. D. Ritchie, Chairman, introduced Dr Cook to the very large audience by giving the background to the Henderson Memorial Lecture Fund, and recalling Dr Cook's long association with Glasgow and the previous Lectures in the series.

Dr Cook, in speaking on 'Tobacco Smoke and Lung Cancer,' discussed the evidence which has been adduced in recent years for the view that tobacco smoking may be the major factor responsible for the progressive increase in the number of deaths from cancer of the lung.

Dr C. L. Hewett warmly congratulated and thanked Dr Cook on behalf of the appreciative audience for an enlightening and thought-provoking lecture. In the evening, Dr and Mrs Cook, together with personal friends, were entertained to dinner as guests of the Section.

It is proposed to publish the lecture later as No. 5 in the 1961 Lecture Series.

Dr Newton Friend—Celebration Dinner.—On Friday, 26 May, a dinner was held in the new Chamber of Commerce Dining Suite, Edgbaston, to celebrate the eightieth birthday of Dr J. A. Newton Friend and to honour his achievements of over half a century's standing in the fields of pure and applied chemistry. The event, arranged jointly by the committees of the Birmingham and Midlands Section of the Institute and the Midlands Section of the Oil and Colour Chemists' Association, was attended by some 100 members together with their wives and friends. Amongst the guests were Alderman and Mrs E. E. Mole, participating in their first social engagement since taking office as Lord Mayor and Lady

By courtesy of the Birmingham Post & Mail

Left to right: Dr J. A. Newton Friend, Mrs G. King, wife of the Section Chairman, and Mr C. E. Hollis

Mayoress of Birmingham; Mr G. Dring, *Vice-President*, and Mrs Dring; Dr H. A. Hampton, President-designate, O.C.C.A., and Mrs. Hampton; Professor K. Mather, Vice-Principal, University of Birmingham, and Mrs Mather; and Mr and Mrs C. E. Hollis.

In proposing the toast to Dr Newton Friend, Mr Hollis, a former student of Dr Friend, drew attention to the several aspects of Dr Friend's career. There was Friend the scientist, Friend the technologist, Friend the archaeologist and historian, Friend the educationalist; combined, these formed the complete personality of Friend the man, whose devotion to his chosen career has been matched only by the distinction he has brought to it. Any one of these facets could form the basis for prolonged eulogy. But to many, he is best known as the former head of the chemistry department of the old Birmingham Technical College (now the College of Advanced Technology), a position he held from 1920 to 1946. The high standards he introduced and upheld in his teaching at the College have now borne fruit in the establishment and development of the new College.

Dr Friend was then presented with a grandmother clock, subscribed for by members of the organizing societies.

In a lively and witty reply, Dr Friend, in reminiscent mood, thanked the gathering for thus honouring him and for their generosity in subscribing to the testimonial fund established for the occasion.

At the conclusion of the proceedings, Mr G. King, M.B.E., Chairman of the Birmingham and Midlands Section, announced that at Dr Newton Friend's request the balance of subscriptions made by members to the fund would be donated to the Benevolent Fund. A similar arrangement was to be made with the benevolent fund of O.C.C.A.

PERSONAL NOTES

Birthday Honours

The Officers and Council extend their cordial congratulations to the following Members, whose names appeared in the Birthday Honours List:

C.B.E. Leslie Faithful Cyril NORTHCOTT, PH.D., D.SC., F.I.M.

O.B.E. Frank BRIERS, B.SC., D.PHIL.
Eric DOWNING, B.SC., PH.D.
Joseph Frederick HIRST, B.SC.
John Leslie PHILLIPS, B.SC.

M.B.E. Ernest Charles William MAYCOCK, B.SC.

News of Hon. Fellows

Sir John Cockcroft, O.M., F.R.S., *Nobel Laureate*, has been appointed Chancellor of the Australian National University, Canberra.

Sir Henry Dale, O.M., F.R.S., *Nobel Laureate*, is to have a Royal Society professorship in medical research named after him. The 'Henry Dale Professorship' is to be endowed from a gift of £100,000 which the Wellcome trustees have made to the Society to commemorate Sir Henry's 'unique services' as their chairman for 22 years, as well as his 'outstanding contributions to science and medicine in a wider context.'

Degrees and Awards

Mr H. Humphreys Jones, *Fellow*, principal of the former Liverpool School of Pharmacy, 1908–50, had the honorary degree of M.A. of the University of Liverpool conferred on him at a congregation of the University on 1 July. He is now aged 85.

Dr J. McDougall, *Associate*, has been awarded the prize in the 1961 Essay Competition run by the Education Panel of the Corrosion Group of the S.C.I. His essay was entitled 'The Microbial Corrosion of Metals.'

Dr R. P. W. Scott, *Fellow*, has been awarded the degree of D.Sc. of the University of London for his work on the theory and practice of gas chromatography.

Dr D. T. A. Townend, C.B.E., *Fellow*, had the honorary degree of D.Sc.Tech. of the University of Sheffield conferred on him at a congregation of the University on 1 July.

Professor F. L. Warren, *Fellow*, has been awarded the South Africa Medal for 1961 by the South African Association for the Advancement of Science.

Leverhulme Research Awards.—Dr L. E. Sutton, *Fellow*, demonstrator in physical chemistry, University of Oxford, has been awarded a Leverhulme Fellowship for studies on the significance of molecular shapes and sizes. Mr M. Kaufman, *Fellow*, senior lecturer in plastics technology, National College of Rubber Technology, has been awarded a Leverhulme Research Grant for his studies on the history and development of the plastics industry. These awards are tenable for periods of up to two years.

Societies and Institutions

Mr A. G. Higgins, Barrister-at-Law, *Fellow*, formerly Assistant Secretary of the Institution of Gas Engineers, has been appointed Secretary. He succeeds Dr W. T. K. Braunholtz, O.B.E., *Fellow*.

Professor Sir Cyril Hinshelwood, O.M., F.R.S., *Nobel Laureate*, *Fellow*, is among 10 new members appointed by the Pope to the Pontifical Academy of Sciences.

Professor Sir Alexander Todd, F.R.S., *Nobel Laureate*, *Fellow*, has been elected Master of the Salters' Company for the year 1961–62.

Association of Public Analysts.—At the recent Annual General Meeting of the Association the following *Fellows* were re-elected officers for the coming year: President, Dr J. H. Hamence; Vice-President, Mr D. D. Moir; Hon. Treasurer, Mr R. C. Spalding; Hon. Secretary, Mr F. A. Lyne; and Hon. Editor, Dr E. C. Wood.

Educational

Dr C. W. Badger, *Associate*, has relinquished his post of lecturer, Nottingham and District Technical College,

to take up an appointment as senior lecturer in inorganic chemistry, Rutherford College of Technology, Newcastle upon Tyne.

Dr T. G. Bonner, *Fellow*, has had the title of reader in organic chemistry in the University of London conferred on him in respect of his post at Royal Holloway College.

Dr E. G. Clarke, *Fellow*, has had the title of reader in chemistry in the University of London conferred on him in respect of his post at the Royal Veterinary College.

Mr A. B. Hedley, *Associate*, has been appointed by the Senate of the University of Sheffield to the Central Electricity Authority Research Fellowship in Fuel Technology, from 1 July.

Dr P. F. Holt, *Fellow*, lecturer in organic chemistry, University of Reading, has had the status and title of reader conferred upon him.

Dr H. E. Nursten, *Fellow*, has been granted leave of absence by the University of Leeds in order to become a research associate in the department of nutrition, food science and technology, Massachusetts Institute of Technology, for one year from 1 July, and to visit subsequently some of the other leading American institutes dealing with higher education and/or research for the food and leather industries.

Dr T. C. Owen, *Associate*, has returned from Vanderbilt University, Nashville, Tennessee, U.S.A., to the department of chemistry and biology, City of Liverpool College of Technology.

Dr J. Rose, *Fellow*, has been appointed Vice-Principal of the Coventry Technical College. He was formerly senior lecturer in physical chemistry, Birkenhead Technical College.

Dr J. B. Stenlake, *Fellow*, senior lecturer in pharmaceutical chemistry at the Royal College of Science and Technology, Glasgow, has been appointed to succeed Professor J. P. Todd, *Fellow*, in the Chair of Pharmacy at the College.

Mr K. Tomlinson, *Fellow*, technical manager, Colgate-Palmolive Ltd, has been appointed a governor of the Salford Technical College.

Academic Visitors to the United Kingdom.—The following members of staff of oversea Commonwealth universities are expected to be in the U.K. until the dates stated: Dr A. D. Campbell, *Associate* (Otago), December; Dr E. Downing, *Fellow* (Fourah Bay U.C.), September; Dr P. P. G. L. Siriwardene, *Fellow* (Ceylon), August.

The following are due to arrive shortly, at about the dates stated: Dr A. K. Bhattacharya, *Fellow* (Saugar), September; Mr B. D. England, *Associate* (Victoria, Wellington), September; Dr H. J. Rodda, *Associate* (Adelaide), September; Professor F. Sebba, *Fellow* (Witwatersrand), August; Professor F. H. H. Valentin, *Fellow* (Natal), October, and Dr G. P. Wannigama, *Associate* (Ceylon), September.

Public and Industrial

Mr T. R. Auchinloss, *Fellow*, assistant managing director of Jeyes Sanitary Compounds Co. Ltd, has been appointed a director of the company.

Mr A. I. Biggs, *Fellow*, formerly director of chemistry, Federation of Malaya, has recently taken up an appointment with the Federation of British Industries, London.

Dr L. Golberg, *Fellow*, has been appointed director of the British Industrial Biological Research Association. It is expected that he will take up this appointment towards the end of the year. He is at present medical research director, Benger Laboratories Ltd.

Mr G. H. Greenhalgh, *Associate*, has been appointed nuclear energy attaché to the United Kingdom Delegation to the European Communities. He succeeds Mr D. H. Hill, *Fellow*, *q.v.*

Mr D. H. Hill, *Fellow*, of the UKAEA, has completed his tour of overseas duty in Brussels and has now joined the Industrial Power Branch (Overseas Section) of the Reactor Group, Warrington.

Mr K. A. R. Julian, *Fellow*, has taken up an appointment with R. & J. Dempster Ltd. He was formerly chief project engineer with Cremer and Warner, consulting chemical engineers.

Mr H. E. Krumm, *Fellow*, Hon. Secretary of the Cape Section of the Institute, has been appointed works manager, African Metals Corporation, Cape Province. He was formerly works chemist.

Dr K. Lakshminarayanan, *Associate*, joined the research department of John Labatt Ltd, London, Canada, in April as research scientist. He was formerly plant biochemist with the Central Botanical Laboratory, Allahabad, India.

Dr J. A. Linton, *Associate*, has recently resigned his position as chemical engineer to the Scottish Gas Board to take up the post of plant manager with the East African Extraction Corporation Ltd, Nairobi, Kenya.

Dr R. Long, *Associate*, has recently resigned his post of senior research chemist, Borax Consolidated Ltd, to take up a position as technical officer with Imperial Chemical Industries Ltd, Heavy Organic Chemicals Division, Billingham.

Mr H. C. Macfarlane, *Fellow*, principal of Harrison & Self, has been appointed Public Analyst and Official Agricultural Analyst for the County Borough of Northampton.

Mr W. G. B. Mills, *Fellow*, has been appointed deputy manager of the Thermoplastics Research and Development Laboratory based at the Silvertown, London, factory of B.T.R. Industries Ltd. He was previously technical director, Dohm Ltd.

Mr S. D. Phillips, *Associate*, has been appointed works manager, North Eastern Tar Distillers (Sadlers) Ltd, and associated companies. He was formerly production manager.

Mr D. E. Ridler, *Associate*, has returned to this country from South Africa, where he was plant superintendent, African Explosives & Chemical Industries Ltd, and is now a plant manager, Imperial Chemical Industries Ltd, Billingham Division.

Mr A. N. Smith, *Associate*, has taken up a post as senior research officer at the New South Wales Department of Agriculture's Wagga Wagga Research Institute. He previously held the post of chemist, Tea Research Institute of East Africa, Kericho, Kenya.

Dr V. Sundaram, *Associate*, has returned to the technological laboratory of the Indian Central Cotton Committee, Bombay, where he is a senior research officer. He was formerly at the Textile Physics Laboratory, University of Leeds.

Dr G. Swann, *Fellow*, assistant managing director of Beck, Koller & Co. (England) Ltd, has been elected to the board of the parent company, Reichhold Chemicals Ltd.

Mr Alec Taylor, *Fellow*, has been appointed general manager, Ernest Ostler Ltd, Newington, Hull. He was formerly works manager, Liverpool Borax Co. Ltd.

Dr J. Taylor, M.B.E., *Fellow*, a director of Imperial Chemical Industries Ltd, has been appointed to the board of Pyrotenax Ltd.

Mr W. L. Wren, *Fellow*, has left his position of chief chemist, Van den Berghs & Jurgens Ltd, to take up an appointment in the personnel division of Unilever Ltd.

Committee on Grants to Students.—The Minister of Education and the Secretary of State for Scotland have appointed the following *Fellows* as members of the Standing Advisory Committee on Grants to Students, the chairman of which is Sir Francis Hill, C.B.E.: Professor A. G. Evans, Dr J. E. Garside, and Mr G. H. Moore. One of the first tasks of the Committee will be to review the standard maintenance grants.

Retirements

Dr W. T. K. Braunholtz, O.B.E., *Fellow*, retired on 20 May as Secretary of the Institution of Gas Engineers, a post he had held since 1937.

Mr A. T. Grisenthwaite, *Fellow*, retired from his position as technical department manager of the Power Gas Corporation Ltd on 31 May, after more than 43 years' service with the company.

Mr F. S. Shadbolt, *Fellow*, area gas examiner, Gas Standards Branch, Ministry of Power, retired on 30 June.

Professor J. P. Todd, *Fellow*, will retire at the end of the present session from the Chair of Pharmacy at the Royal College of Science and Technology, Glasgow.

British National Committee for Chemistry.—In *J.*, 230, the name of the representative of the Institute on the British National Committee for Chemistry (Royal Society) should have been Mr G. Dring, who has succeeded Mr R. C. Chirnside.

Section Activities

ABERDEEN AND NORTH OF SCOTLAND

Annual General Meeting. The A.G.M. of the Section was held in the University Union on 25 April. The following Officers and Members of Committee were elected: Chairman, Dr H. A. Robertson; Vice-Chairman, Dr J. A. Lovern, F.R.S.E.; Hon. Secretary and Treasurer, Dr P. N. Hobson; Hon. Auditor, Dr W. J. Donaldson; Members of Committee, Drs H. G. M. Hardie and C. F. Mills and Mr W. Moser. Mr D. W. Menzies, of Aberdeen Academy, was co-opted to the Committee to ensure liaison with other bodies organizing lectures for school children so that there would be no overlapping with our Christmas Lectures.

BRISTOL AND DISTRICT

Summer Visits. On 15 June members and friends travelled to the pleasant Cotswold village of Winchcombe for a visit to the nearby Postlip Mill of Evans Adlard and Co. Ltd. The Mill has stood for 200 years and draws its water from two streams. The party was welcomed by Mr E. H. Milvain who gave a brief description of the history and products of the company, after which his staff led a conducted tour through the works.

Cotton rags were once the main raw material but are now uneconomic, and fibres such as cotton linter, woodpulp including mulberry, esparto grass and so on are mainly used for the production of absorbent or filter papers.

The process of beating the fibre, forming the felt, watermarking, drying and reeling were all shown, as also were the subsequent precise slitting for car oil-filters and circle cutting for the food trade, laboratory use, etc. Highly-specialized paper washers are also cut. Impregnated and glass-fibre papers are made and a comprehensive display of products was later seen in the laboratory.

The morning was all too short for the visitors, but another engagement in Worcester had to be met after an enjoyable lunch at The George.

At the Worcester Royal Porcelain Works the party was shown some priceless specimens of the art of porcelain in the Dyson Perrins Museum. A guide then conducted the group past stacks of water-worn flint pebbles, crystalline quartz, feldspar and so on to the grinding and mixing room, where the raw materials are blended in water and filtered off to paste consistency. This is then spun on a partly-mechanized potter's wheel or poured as a slurry into plaster of Paris moulds until a de-watered shell has formed. Excess 'slip' is poured out and the form allowed to dry further before removal.

Firing and glazing by hand or spray are followed by decoration either freehand or by transfer from engraved

copper plate to paper to porcelain, a firing being required after each colour. Teams of workers produce numerous hand-moulded statuettes, flowers and so on, which are largely exported.

Though not actually seen in the making, such familiar laboratory ware as Buchner funnels and outsize evaporating dishes were in evidence.

The day was rounded off by a drive to the Malvern Hills overlooking the Vale of Evesham, through which the homeward run was made.

CARDIFF AND DISTRICT

Infra-Red Spectroscopy. Dr L. J. Bellamy paid his second visit of the year to the University of Cardiff on 19 April. On this occasion he addressed the Section and the South Wales Section of the Society of Chemical Industry on 'Infra-red Spectroscopy.'

Dr Bellamy gave an account of various applications of this method in organic chemistry. Dealing with its use for structural diagnosis, he emphasized that the infra-red technique is only one of many tools available, and as far as possible should be used in conjunction with these other aids and not in isolation.

In many ways the most important advance in this field in recent years has been in our greater understanding of the behaviour of group frequencies, and of the factors which cause them to move about in the way they do. These studies have brought to light many interesting relationships between frequency shifts and changes in such properties as reaction rate, σ-values and so on. Although devised primarily to show the causes of the frequency shifts, such relationships can, on occasion, be exploited to derive reaction-rate data directly from the infra-red spectra.

Some examples were given in which the theory is used to devise special molecules likely to have very unusual group frequencies, and it was shown that these can be confirmed experimentally. Other applications, in rotational isomerism, in studies on various types of hydrogen-bonding, in bacterial chemistry and in studies on crystals and fibres using polarized radiation, were all briefly discussed.

Modern Legislation in Relation to Food Additives. On 28 April the Western Section of the Society for Analytical Chemistry and the Food Group of the South Wales Section of the Society of Chemical Industry joined with the Section in welcoming Mr C. A. Adams, C.B.E., *Barrister-at-Law*, to Cardiff. A civic reception was afforded the speaker and his accompanying visitors, and committee members of the Societies were invited to join a private luncheon given at the City Hall by the Lady Mayor and Mayoress.

During the afternoon the party visited the gelatine factory of Messrs P. Leiner at Treforest.

The Physics Lecture Theatre at the University of Cardiff was filled to capacity to hear Mr Adams's address on 'Modern Legislation and Food Additives.' The Chair was temporarily vacated by Mr J. S. Millar in favour of Mr S. Dixon, the former City Analyst, who, in the discussion that followed, was soon involved in friendly clashes with the lecturer.

A vote of thanks was proposed by Mr MacLoughlan.

Annual General Meeting. The twenty-sixth A.G.M. of the Section was held on 26 May at the Royal Hotel, Cardiff, with Mr H. K. B. Rout in the Chair.

Reports were presented by the Secretary and the retiring District Member of Council, Mr S. J. H. O. Chard, who took the opportunity of introducing to the meeting the newly-elected Member of Council, Mr P. F. Ellis, M.B.E., who had come up from Neath.

A ballot was held to elect new committee members to replace the retiring members, and Dr N. M. Cullinane, and Messrs Chard and S. Dixon were elected.

The new chairman, Mr J. S. Hughes, paid tribute to his predecessor, and expressed the regret of the meeting that Mr Rout would shortly be leaving the district. The meeting then outlined the Section programme for the coming year and discussed suggestions for improving and extending Section activities.

DUNDEE AND DISTRICT

Annual General Meeting. The A.G.M. of the Section was held in the Department of Chemistry, Queen's College, Dundee, on 5 May. The Minutes of the previous Annual General Meeting, the Committee's Report for 1960 and the Financial Statement for the year ending 31 December, 1960, were approved.

In general, the session has been very successful, with an average attendance at meetings of 50 to 60. This is probably due in part to more popular lectures and to the inclusion of joint meetings with other Societies in Dundee. The Educational Symposium in January proved to be one of the most popular meetings.

The following Officers and Members of Committee were elected for the ensuing year: Chairman, Dr D. G. Neilson; Vice-Chairman, Mr W. Johnston; Hon. Secretary-Treasurer, Mr P. H. Broughton; Members of Committee, Drs K. R. Hargreaves and R. Roger, and Messrs D. R. Brown, R. S. Nicolson, J. Smart and J. Wylie (Immediate Past Chairman); Mr J. C. Smith kindly agreed to serve again as Hon. Auditor.

Mr Wylie proposed the vote of thanks to the retiring Officers, making special mention of the invaluable work carried out by Dr Hargreaves over the last three years as Hon. Secretary-Treasurer.

EAST MIDLANDS

Works Visit. On 11 May members of the Section paid a most enjoyable visit to Pet Foods Ltd, Melton Mowbray.

The visitors were welcomed by Mr Harms on behalf of the company directors, and light refreshments were provided. A short introductory lecture on the aims,

development and processes of the industry was given by Mr Harms, who drew attention to the fact that the industry, founded in 1937, had made rapid progress in the last 10 years. The present value of the market for prepared foods for dogs, cats and birds is approximately £20,000,000 annually.

It was stressed that every effort is made to ensure a balanced diet in the prepared foods. Typical deficiencies which occur in the diet of household pets include lack of phosphates, fat and vitamin B_1. Hence calcium phosphate is introduced in the form of ground bone, and fats and vitamin B_1 are added to the products.

Each member of the party was provided with a clean white coat and cap before beginning a two-hour tour of the works. The five guides of the groups were untiring in their efforts to demonstrate every aspect of the processes. The raw materials for these processes include fish, whale meat and offal, all of which are either received in the frozen state or are compressed and frozen immediately on arrival at the factory. The deep-freeze store is one of the largest in Europe. The frozen blocks of meat are reduced to small cubes, and are then mixed by weight with fats and carbohydrates before being transferred to batteries of steam-heated coppers. The product is sterilized in the cans, which are automatically filled, labelled and packed.

Finally, the visitors were entertained by the company at a local hotel. At the conclusion of the buffet supper Mr E. R. Pike proposed the vote of thanks for the excellent hospitality.

GLASGOW AND WEST OF SCOTLAND

Junior Lecture. The Eleventh Annual Junior Lecture for pupils in local senior secondary schools was given by Mr J. J. Lawson, of the Shell Refining Co. Ltd, Ardrossan, in the University of Glasgow on Wednesday, 7 June. His topic was 'The World's Oil.' Professor Ritchie was in the Chair.

Mr Lawson began by outlining the origin and formation of oil in the earth's crust, and described its recovery in the crude state. The composition of the oil was indicated, and its breakdown to tailor-made products of desired properties was illustrated. The remarkable range of substances so obtained was shown by means of samples, and the importance of oil in providing mechanical power for our present way of life was described.

The lecturer continued with a brief description of how a search for oil is carried out and concluded with remarks on the future requirements of sources of energy, including coal, atomic energy and oil.

The lecture was illustrated with slides and two short films, as well as models to show drilling, pumping and cracking operations. It was, as usual, well attended, and at its conclusion Mr Alan Hepburn, of Paisley Grammar School, proposed the vote of thanks to Mr Lawson for his very interesting lecture.

LONDON SECTION

Chemotherapeutic Research. A joint meeting with the Luton Scientific Society was held at Luton on 19 April. The meeting was opened by Miss N. Boothman, Chairman of the Luton Scientific Society, and the Chairman for the evening was Mr F. C. Hymas, who introduced the lecturer, Dr F. L. Rose, F.R.S.

Dr Rose dealt first with the problems that engage the chemist in his search for leads towards the preparation of useful chemotherapeutic agents, and showed how the majority of those in use today had evolved from some initial observation relating chemical structure to biological effect. The latter could not, however, be considered as a single entity. It was rather a complex made up of many factors, all structurally specific, which govern not only the intrinsic activity of a chemical compound against a target cell, but also the mechanism by which the compound gains access to that cell in the tissues of the animal host.

The problems presented were illustrated by attempts to devise anti-tubercular agents by rational means, and also a study of the relationship between fine chemical structure amongst a series of sulphonamide drugs and their capacity to concentrate and persist in the bloodstream of experimental animals and man.

Some discussion followed, and the proceedings closed with the vote of thanks proposed by Dr J. H. Burgoyne.

Visit to the Radiochemical Centre. On 26 April, a party of members visited the Radiochemical Centre at Amersham. They were welcomed by Dr C. C. Evans who, in an introductory talk, outlined the work of the Centre. He explained that the Centre is part of the research division of the United Kingdom Atomic Energy Authority, and is concerned with the production of radioisotopes in the many forms required by users in medicine, industry and research. Although it is in many ways a scientific establishment, the Centre is organized on commercial lines and acts as the outlet for the Atomic Energy Authority's radioactive by-products. These by-products are obtained initially from natural sources, from fission products and by irradiation in nuclear reactors or in accelerators such as the cyclotron.

The party split into two groups and toured the Centre. The inorganic and new organic laboratories were visited, and in each case the type of work being done was explained; members were able to watch operations being carried out by remote control in heavily-shielded cells. In the organic department the wide range of compounds containing ^{14}C and tritium were very vividly illustrated.

In the department devoted to processing the natural radio-elements, the party had an opportunity to see in detail the method of construction of heavily-shielded enclosures. The operations involved in the packing and despatch of radioactive solutions was illustrated in

the dispensing section and in the despatch department, and in the main office the visitors gained some idea of the complexity of the commercial operations involved in ensuring the arrival of the correct amount of an isotope at a pre-arranged time and place.

At the conclusion of the visit the party was entertained to tea, and Mr N. Lindop thanked the director and his staff for an instructive and entertaining afternoon.

Visit to the National Institute for Medical Research. On 6 May a group of members visited the Mill Hill Laboratories of the National Institute for Medical Research.

The party was welcomed by Dr J. Walker, head of the division of organic chemistry, who outlined the nature of the work that was carried out at the Institute. Dr R. M. Evans expressed the appreciation of the Section to Dr Walker and the members of the chemistry and biochemistry divisions for the great trouble they had taken in preparing the exhibits, and thanked them in particular for allowing the numbers of the party for this popular visit to be increased appreciably.

In the section dealing with synthetic organic chemistry, Dr Walker described advances in the chemotherapy of malaria over the past decade, and Miss N. C. Johnston gave a most interesting account of the isolation and action of 'Queen Bee' substance, a compound that inhibits the formation of queen cells in the hive.

The increasing importance and expansion of the polypeptide fields of chemistry were well illustrated in the demonstration of automatic counter-current distribution techniques by Dr D. F. Elliott, and the ion-exchange chromatography of amino acids by Dr S. Jacobs. Improved analytical techniques were represented by new methods for the detection of low concentrations of sulphur dioxide by Mr T. Nash, and an automatic scanner for the detection of radioactive substances on paper chromatograms by Dr A. M. White.

Extensions of the techniques of gas chromatography were described by Dr A. T. James, who illustrated their use in the study of fatty-acid biosynthesis.

The broad spectrum of activities covered by the demonstrations proved very popular and interesting. The freedom to move between the exhibits was greatly appreciated, and all the members of the party are indebted to the staff of the National Institute for Medical Research for a most interesting and stimulating morning.

Visit to Spillers Ltd. A party visited the Millennium Mills of Spillers Ltd on 17 May. After some preliminary information on outputs and sources of grain had been given, an extensive tour of the mill and laboratories was made. Detailed explanations were given at all stages of the complex operations entailed in modern milling techniques. An impressive feature was the elaborate procedure and equipment for cleaning the grain before use. This was followed by a mellowing stage and the blending of different wheats to produce flour of desired and constant characteristics. In the milling process, the wheat grains are 'broken' and sieved, the wheat skins and coarse material returning to the mills and being recycled in this way four times. The finished flour is packed automatically in sacks or paper bags. The tour ended with a visit to the laboratories where the area chemist, Mr Key, and his staff explained the testing methods used. The test bakery, where the baking qualities of the various types of flour are checked, was also seen.

At the end of the afternoon the party was entertained to tea, during which many questions were asked and some interesting discussion took place. Finally, Mr J. R. C. Carter and his staff were thanked for a very interesting and instructive visit.

MID-SOUTHERN COUNTIES

Annual General Meeting. For the first time since its formation, the Section travelled to the Isle of Wight for the A.G.M. A large party of members and guests assembled at an early hour at Southampton on 27 May and travelled by one of the 'Red Funnel' steamers so familiar to thousands of holidaymakers. The weather was perfect and the journey down the Solent was most pleasant. The boat passed by the Scanning Tower at Calshot, which had been visited by a number of members and friends who had recently taken part in the Annual Conference at Southampton.

The Annual General Meeting was held at the Fountain Hotel, Cowes, with Mr D. H. Bell in the Chair. In his Annual Report Mr Bell said that the year 1960–61 had been one of the busiest for the Section and certainly the most memorable. It had been a great privilege for the Mid-Southern Counties Section to have played some part in the organization of the Annual Conference held at Southampton in April and it was gratifying to know that the arrangements had given so much pleasure. During the year 14 lectures had been held in various parts of the Section area and in addition a most successful lecture had been given by Professor R. S. Nyholm, F.R.S., to sixth-form science students at present attending grammar schools in the Southampton area. It was hoped to arrange two similar lectures next session.

Mr Bell wished Dr J. L. Latham, Member of Committee, success in his new appointment as lecturer in physical chemistry, Harris College, Preston. The Committee had invited Dr J. W. Griffin, head of the department of chemistry and biology at Portsmouth Technical College, to take his place for the ensuing year. Officers re-elected were: Hon. Treasurer, Mr R. W. Watridge; Hon. Recorder, Mr S. L. Kidman; and Hon. Secretary, Mr T. F. McCombie. The Chairman paid a special tribute to Dr R. E. Parker, Mr McCombie and Mr Watridge for the part they had played in the organization of the Annual Conference.

After an excellent lunch, the party enjoyed a coach tour of the Isle of Wight. Tea was taken at Alum Bay

and the party returned to Southampton in the early evening after a most enjoyable day.

CAPE

Annual General Meeting. The thirty-sixth A.G.M. of the Section was held in the New Chemistry Lecture Theatre, University of Cape Town, Rondebosch, on 27 April. The following members were elected Officers and Members of Committee for 1961: Chairman, Professor J. E. Kench; Hon. Secretary, Mr H. E. Krumm; Hon. Treasurer, Mr W. H. Seath; Members of Committee, Drs R. Arnold, M. Lamchen and A. M. Stephen.

The Chairman informed the meeting that the Section had made arrangements to hold the Second Paul Daniel Hahn Memorial Lecture, in conjunction with the Royal Society of South Africa, in October. Professor F. G. Holliman, of the University of Cape Town, had kindly accepted an invitation to deliver the lecture.

After the adoption of the report of the Hon. Secretary and the Hon. Treasurer's financial statement, the meeting proceeded to the main business of the evening, which was an address by the Chairman, Professor J. E. Kench, on 'Chemical Pathology—A Progress Report.'

The Chairman said that the chemical pathologist's concern is with metabolic disturbances which may lead to or be associated with human ill-health. This special but wide field is expanding continuously into the field of general and comparative biochemistry, to the concepts and techniques of which is due much of the remarkable progress achieved in the last two decades. Determination of the limits of normal variation in body constituents is a necessary prerequisite of detecting deviation from the norm. Such normal variation is made up of changes due to race, age, sex, diet, time of day and situation; in fact, it is compounded of all those factors, genetic and environmental, nature and nurture, which together confer unique characteristics on the individual. The relative importance of these variables was discussed against certain ideas considered by the speaker to be important in the chemical pathologist's thought and work: (1) the relation between chemical structure of molecules and their behaviour as components of cells; (2) the importance of evolution of molecular species as the basis of biological evolution; and (3) the concept of degenerative change in cells as a relative or absolute decline in activity of more recently acquired enzymic systems. The roles of gene–enzyme relations and coenzymes (vitamins and hormones), negative feed-back and other mechanisms were discussed in illustration.

Meaningful advice on human health and disease from the biochemical view-point is possible only if a great number of such interrelated systems are fully appreciated and, if possible, controlled. The chemical pathologist will endeavour, particularly by his studies of phenomena such as permeability and active transport of substances through membranes of cells and subcellular particles, to add to understanding of human diseases at the molecular and cellular level.

Dr J. Largier proposed the vote of thanks.

DECCAN

The Sandalwood Tree. At a meeting held on 25 May at the Indian Institute of Science, Bangalore, Dr P. S. Rao, chief research officer, Forest Research Laboratory, Bangalore, gave a lecture on 'The Sandalwood Tree and its Problems.' Professor P. S. Sarma was in the Chair.

Dr Rao said that the term 'sandalwood' is used with reference to trees belonging to entirely different genera and families. Thus the Australian sandalwood is *Eucarya spicata* (syn. *Santalum spicatum*) and two more species of Santalum (*S. pressianum* and *S. lanceolatum*); the African sandalwood is probably *Osyris tenuifolia*, while the Indian (or East Indian) sandalwood is *S. album*. By far the most important sandalwood is the last of these.

S. album is a native of South India and the Malayan Archipelago. In India it occurs wild in the States of Mysore, Madras and Andhra, and attempts are being made to grow it in other states also. The heartwood and roots of this tree contain a very valuable, sweet-smelling essential oil, which is extensively used in perfumery and to a limited extent in medicine. It is one of the important materials earning foreign exchange for India, being exported chiefly to the U.S.A. and to some extent to the U.K.

In recent times 'spike disease' is threatening to exterminate the forests in India. It is believed to be caused by a virus, and a detailed study of its origin, spread and control is urgently needed if the Indian forests are to be saved from destruction. This work is being undertaken at the Forest Research Laboratory.

Dr B. H. Iyer proposed the vote of thanks.

WESTERN INDIA

Annual Dinner. The Annual Dinner of the Section was held on 11 April at the National Sports Club, Bombay, with Dr V. R. Khanolkar, Vice-Chancellor, University of Bombay, as the chief guest. Dr H. S. Mahal, Chairman, welcomed Dr Khanolkar and spoke of the gradually increasing activities of the Section. He asked for the members' continued co-operation in furthering these activities. Dr Khanolkar congratulated the Section for making its presence felt in the academic and industrial circles in and around Bombay. He referred to the growing importance of chemistry as a profession, and indicated the wide fields that are open to the chemist of today for serving the cause of science and the nation.

Dr K. A. Hamied, when proposing the vote of thanks, made particular reference to the spirit of fellow-feeling among the members of the Institute all over the world. The function was concluded with a show of magic.

News and Notes

EXHIBITIONS

Chemical Industries Tour.—Ashton & Mitchell Travel Ltd announce that they are organizing a tour in connection with the 24th Exhibition of Chemical Industries to be held at the New York Coliseum from 27 November to 1 December. It is expected that travel by jet air service, accommodation at a leading New York hotel and transport between airports and hotels will cost under £200 per person. Departure on 25 November is proposed, with a return to this country on 2 December. Further details are available from Ashton & Mitchell Travel Ltd, 2 Old Bond Street, London, W.1.

Exhibition of Laboratory Apparatus.—An exhibition of modern chemistry laboratory apparatus is to be held in the Royal College of Science and Technology, Glasgow, on Wednesday, Thursday and Friday, 20, 21 and 22 September, respectively. The Exhibition will remain open from 10 a.m. to 7 p.m. on Wednesday and Thursday, and from 10 a.m. to 12.30 p.m. on Friday. About 20 firms will be exhibiting products.

O.C.C.A. Technical Exhibition.—Preliminary arrangements for the Fourteenth Technical Exhibition of the Association have been completed. The Exhibition will take place from 26 February to 1 March, the hours of opening being from 3 p.m. to 7 p.m. on the first day and from 10 a.m. to 7 p.m. on the remaining three days. Both the Old and the New Halls of the Royal Horticultural Society, Westminster, London, S.W.1, will be used. The closing date for receipt of applications for stand space is 4 September. The theme of the Exhibition will be the presentation of technical advances in those industries supplying the paint, varnish, printing ink, linoleum and other allied industries. The technical advances may relate to new products, new knowledge relating to existing products and their use, or existing knowledge which is not generally available in the consuming industries. There is no charge for admission. Further details may be obtained from the General Secretary, R. H. Hamblin, Esq., Wax Chandlers' Hall, Gresham Street, London, E.C.2.

MEETINGS AND CONFERENCES

Carbohydrate Chemistry.—An International Symposium on Carbohydrate Chemistry, sponsored by the Chemical Society in association with the University of Birmingham, will be held in Birmingham on 10–20 July, 1962. Further particulars will be published by the Society in due course. Copies of the announcement will be sent, when available, to those who apply to the General Secretary, The Chemical Society, Burlington House, London, W.1. Papers read at this meeting will not be published in full in collected form.

Chemistry in the Service of Medicine.—The Faculty of the History of Medicine and Pharmacy of the Society of Apothecaries of London has chosen 'Chemistry in the Service of Medicine' as the theme of its second annual congress, which is to be held in London on 28–29 September. The Chemical Society is co-operating in this meeting, and the last of the four sessions will be held in the Chemical Society's rooms in Burlington House. Among those who have already agreed to speak at the Congress are Professor Sir Alexander Todd, F.R.S., *Nobel Laureate*, Professor Sir Charles Dodds, M.V.O., F.R.S., Professor Alexander Haddow, F.R.S., and many others. Application forms for membership of the Congress and copies of the programme may be obtained from the Honorary Secretary, Dr F. N. L. Poynter, The Wellcome Historical Medical Library, Euston Road, London, N.W.1.

Chemical Institute of Canada.—The 44th Canadian Chemical Conference and Exhibition of the C.I.C. will be held at the Queen Elizabeth Hotel, Montreal, on 3–5 August. The Conference is arranged in several divisions, including chemical economics, analytical chemistry, chemical education, chemical engineering, inorganic chemistry, organic chemistry, physical chemistry, rubber chemistry and biochemistry. Further details may be obtained from the C.I.C. at 48 Rideau Street, Ottawa 2, Ontario, Canada.

Conférence des Arts Chimiques.—The Conférence Internationale des Arts Chimiques will take place from 25 April to 4 May at the Maison de la Chimie (Centre Marcelin-Berthelot), 28 bis, rue Saint-Dominique, Paris 7e. Information on the proposed schedule for the Conférence may be obtained from that address. The programme at present includes European Meetings on Chemical Engineering, European Meetings on Corrosion and 'Journées Techniques de Paris,' the latter subdivided under such headings as petroleum chemistry, rubber, plastics, nuclear techniques, aerosols and prevention of atmospheric pollution. In conjunction with the Conférence, the VIe Salon International de la Chimie will be held at the Centre National des Industries et des Techniques (C.N.I.T.), Rond Point de la Défense, Puteaux, Paris, during the same period. The general headquarters of the Salon are also at 28 bis, rue Saint-Dominique.

Food Science and Technology.—The First International Congress of Food Science and Technology, to be held at the Imperial College of Science and Technology on 18–21 September, 1962, is divided into four sections which will run concurrently throughout the four days of the Congress, except for a number of periods occupied by Plenary Sessions and Congress Symposia. The sections are devoted to the following aspects of foods: chemical and physical; biological and

microbiological; quality, analysis and composition; and manufacture and distribution. The registration fee for the Congress is £7 10*s*. Further details may be obtained from the Honorary Secretary, F. J. Griffin, 14 Belgrave Square, London, S.W.1.

Food Technology.—The First European Symposium on Food Technology will take place in Frankfurt on 26–27 October and not on the dates given in *J.*, 249. This meeting will therefore not clash with the symposium on the freeze-drying of foodstuffs to be held at Borough Polytechnic on 19–20 October.

International Congress for Microbiology.—The Eighth International Congress for Microbiology will be held in Montreal, Canada, from 19 to 25 August, 1962, under the auspices of the Canadian Society of Microbiologists. The headquarters of the Congress will be in the Queen Elizabeth Hotel. There will be five sections: structure and function; agricultural microbiology; industrial microbiology; medical and veterinary microbiology; and virology. Two or more symposia are being arranged in each section, and it is expected that many, if not all, of the symposia, will be published. All correspondence concerning the Congress should be addressed to Dr N. E. Gibbons, Secretary General, VIII International Congress for Microbiology, National Research Council, Ottawa 2, Canada.

Plastics Institute.—The President's Reception and Conversazione will be held on 25 July, following the Annual General Meeting at the headquarters of the British Plastics Federation, 47–48 Piccadilly, London, W.1. The programme includes a trip down the river by steamer from Charing Cross to Greenwich, an evening in the National Maritime Museum and a return by steamer. Further details may be obtained from the Secretary of the Plastics Institute, 6 Mandeville Place, London, W.1.

Polymers of the 1960s.—A full-day Symposium on this topic is to be held by the Manchester and District Section on 4 October at 9 a.m. in the Department of Chemistry, The University, Manchester. The latest developments in the field of polymer chemistry will be discussed under four main headings. A lecturer who is distinguished in each particular section will give a main lecture and this will be followed by other contributions. The sections of the Symposium and the proposed lecturers are: Films—Dr P. T. Standring, I.C.I. Ltd; Polyolefins—Mr R. Hayes, British Hydrocarbon Chemicals Ltd; Delrin—Dr G. F. C. Barrett, Dupont Co. (United Kingdom) Ltd; and Elastomers—Dr F. Watson, Rubber and Plastics Research Association of Great Britain.

Admission to the Symposium will be by ticket only and further details can be obtained from Mr H. H. Armstrong, Science Department, College for Further Education, Wellington Road South, Stockport, Cheshire.

RECENT PUBLICATIONS

Clean Air Year Book.—The National Society for Clean Air (Field House, Breams Buildings, London, E.C.4) has recently published *The Clean Air Year Book, 1961*, price 2*s*. 6*d*. net. This issue has as a new feature a table of Local Authorities constituting the 'black areas,' showing the progress they have made in the setting up of smoke-control areas under the Clean Air Act, 1956, their eventual targets and the dates by which they expect to reach them. The contents also include a progress review for 1960, short articles on the work of allied organizations, a summary of the Clean Air Act and regulations made under it, and various other tables and statistics.

Radiation Safeguards.—Requirements for the protection of workers against ionizing radiations and other hazards from radioactive substances are laid down in draft Regulations published recently by the Ministry of Labour. *Ionising Radiations (Sealed Sources) Regulations, 1961* (H.M.S.O., 9*d*.), covering 'sealed sources' and certain machines and apparatus producing ionizing radiations, is published as a Statutory Draft in accordance with Section 129 of the Factories Act, 1937.

Approved Names.—The General Medical Council has published a supplementary list of Approved Names, dated May, 1961. The list is available from the Secretary, British Pharmacopoeia Commission, 44 Hallam Street, London, W.1.

Rare-Earth Metals.—The increasing use of the less familiar metals is reflected in a recent announcement by Johnson Matthey & Co. Ltd that they are now able to supply scandium, yttrium and most of the 14 rare-earth metals in sheet form in thicknesses down to 0·001 in and with a maximum width of 3 in. The sheet is available either cold-worked or annealed. This is the latest development in the company's production of the metals of this group, which have previously been available as ingots and in some cases as wire of diameters down to 0·02 in.

The company also announces that it is now producing zone-refined tellurium of high purity. The total metallic impurity content, excluding selenium, is less than 5 p.p.m. and is normally in the region of 1 p.p.m. The selenium content does not exceed 5 p.p.m. The tellurium is supplied in half-round bars approximately 1 in by $\frac{1}{2}$ in.

South African Chemical Institute.—Professor D. H. R. Barton, F.R.S., has accepted an invitation to be the guest at the 14th Convention of the South African

Chemical Institute in Durban this month. He will be accompanied by Mrs Barton and will visit the universities in Salisbury, Pretoria, Pietermaritzburg and Cape Town.

Study-Tour in Germany. Thirty-two heads of departments of chemistry from technical colleges in England, Wales, Scotland and Northern Ireland visited the Ruhr from 7 to 14 May, considering arrangements for the education and training of chemical technicians in Germany. The programme was arranged by the Kultusministerium of North Rhine–Westphalia at the request of the Ministry of Education, and included visits to industrial plants and laboratories as well as to Berufs- and Ingenieur Schulen.

In Germany the training of chemical assistants for industry is arranged according to a more comprehensive plan than in this country, and in the firms visited the professional scientists and technologists led larger teams of more highly-trained assistants than is the practice here.

Arrangements are being made for the considered views of the heads of departments on the advantages and disadvantages of the German system to be taken into account when schemes for the education of chemical assistants in England come under review.

U.K. Oil Consumption.—According to figures issued by the Petroleum Information Bureau, United Kingdom oil consumption rose by 16·9 per cent in 1960 compared with the previous year, reaching some 42½ million tons (excluding bunkers for ships engaged in foreign trade). Among major products, fuel oil consumption showed the greatest increase, being more than a quarter as much again as in the previous year and reaching about 17½ m. tons. There was a remarkable growth in chemical feedstock, which totalled about 1½ m. tons against 1 m. tons in 1959. Detailed statistics of consumption in 1960 and 1959, together with figures showing the growth of oil demand in the U.K. as compared with 1938, 1948 and 1958, are available from the P.I.B., 29 New Bond Street, London, W.1.

CORRESPONDENCE

THOMAS MALKIN, 1897–1961

SIR,—The death of Dr Malkin on 25 April, more than two years before the age of retirement, has come as a serious blow to the University Departments of Chemistry. His death is also a great loss to those national and international scientific organizations to which his work and service had contributed so much, and to the cause of education in the South-West. But in particular we mourn the untimely passing of a loyal friend and colleague who gave almost the whole of his active life to the service of the University in the teaching and expansion of chemical knowledge. Malkin came to Bristol as a research assistant in 1925, and subsequently became lecturer, senior lecturer and reader.

Malkin gave freely of his time to the Chemical Society, the Society of Chemical Industry, amongst other ways as Chairman of the Oils and Fats Group, and to the Royal Institute of Chemistry. He recently completed a survey of oil and fat research in Europe, and only last year was honoured by being elected President of the International Society for the Study of Fats.

We are anxious that Malkin's name should be permanently associated with the Chemistry Departments of the University of Bristol, and to this end we are raising a fund to endow an annual prize to be awarded to the most promising student in the Honours School of Chemistry at the end of the second year of study.

We invite your readers to give generously in memory of a colleague, a teacher and a distinguished contributor to the advancement of chemical knowledge. Contributions may be sent to Dr F. H. Pollard, payable to the 'T. Malkin Fund.'

W. BAKER
D. H. EVERETT

The Departments of Chemistry,
The University,
Bristol, 8

MONOMERS FROM PETROLEUM

SIR,—On *J.*, 209 you published a brief summary of a lecture which I gave at the recent symposium on 'Chemicals from Petroleum.' It is, of course, difficult to compress the contents of a fairly long lecture into two paragraphs, and it is equally difficult to emphasize the salient points.

However, since the summary contains one or two errors of fact, I trust that you will allow me to correct them. I am credited with saying that alkyl and aryl butenes are usually produced by dimerization. What I actually said, of course, is that the lower α-olefins can be made by the dimerization of propylene or butene-1, or by the addition reactions of these olefins. As examples I quoted 2 ethyl hexene-1 and 4 methyl pentene-1. As far as I am aware, these reactions have not yet been commercialized for the manufacture of monomers.

The report also states that the usual starting point for the substituted di-olefins is n-butene. This is certainly not the case for isoprene, and is not yet true of chloroprene. The normal starting point for chloroprene is acetylene.

L. HOLLIDAY

Shell Chemical Co. Ltd,
170 Piccadilly, London, W.1

[We regret any misrepresentations of Mr Holliday and the other speakers, whose lectures may have suffered in condensation.—ED.]

OBITUARY

Arthur Jacobus. *B.* 26.11.1897. *Ed.* Friedrich-Wilhelms Universitaet, Berlin, and Techniche Hochschule, Berlin-Charlottenburg, 1920–26. Dr. Phil. He was appointed an analytical chemist in the public analyst's laboratory, Berlin, in 1927. Two years later he became a research chemist and joint managing director, Chemische Fabrik Jacobus, GmbH, Berlin-Tagel. In 1932 he took a post as research chemist and managing director at Chemische Fabrik 'Jacart,' GmbH, Berlin, where he remained until 1936. Shortly afterwards he came to this country, and in 1941 he was appointed research chemist to G. Nelson, Dale & Co. Ltd, Warwick, a post which he held for the rest of his life. (*A.* 1947, *F.* 1957) *D.* 27.2.61.

Thomas Rickman Lynam. *B.* 28.7.07. *Ed.* Hanley High School; North Staffordshire Technical College, 1925–28. He remained at the College for a further two years as an assistant in the testing laboratory, and in 1930 became a research assistant in the department of refractory materials, University of Sheffield. In 1931 he was appointed chief chemist and technologist to the Oughtibridge Silica Firebrick Co. Ltd, where he remained until the time of his death, when he was general manager and director. He served on a number of committees, including the committee of the Sheffield, South Yorkshire and North Midlands Section of the Institute, and was co-author of several scientific papers. (*F.* 1944) *D.* 4.2.61.

Henry Murray. *B.* 20.6.05. *Ed.* St Andrew's College, Dublin; Royal College of Science for Ireland, 1923–27. B.Sc.(N.U.I.). After a year's research at the University of Cambridge, he took a post as a research chemist at Magadi Soda Co. in 1927. He became assistant works manager at Burgoyne, Burbidges & Co. Ltd in 1933, and two years later set up as a manufacturing chemist. He joined the Royal Air Force in 1939, and served until 1945. On demobilization, he was appointed chemist and works manager to Dae Health Laboratories Ltd. The following year he became a private consultant, and in 1947 took a post as chief chemist and works manager, Money's Patents Ltd, until 1951, when he joined G. H. Kay Ltd as manager, chemicals department. Finally, he was appointed manager, pharmaceutical and dyestuffs departments, Joseph Weil & Son Ltd, a post which he held for the rest of his life. (*A.* 1927, *F.* 1958) *D.* 15.2.61.

Henry Naylor. *B.* 15.7.1891. *Ed.* Blackburn Technical College, 1913–14, 1919–23. He began his career in 1905 as a cashier at the Bank Top Mill Cotton Co. (Blackburn) Ltd, where he remained until 1914. He then joined H.M. Forces, and was later taken prisoner. In 1922 he was appointed a research chemist at the British Cotton Industry Research Association, a post which he held until his retirement in 1957. (*A.* 1922, *F.* 1925) *D.* 18.2.61.

Eric Reid. *B.* 6.12.02. *Ed.* Birkenhead Institute; Liverpool Central Technical School, 1920–26. He joined Lever Bros Ltd, Port Sunlight, as an assistant chemist in 1919, and remained with the firm for the rest of his life. For some years he was a works chemist at the hydrogenation plant, Bromborough, later becoming assistant works manager and then manager. (*A.* 1926, *F.* 1930) *D.* 9.2.61.

Arthur John Griffiths Smout. *B.* 18.11.1888. *Ed.* Birmingham Municipal Technical School, 1904–11. He served for four and a half years as a pupil in the chemical laboratory of a metal works and in 1911 became assistant chemist at Elliott's Metal Co. Ltd. In 1914 he was appointed chief chemist in the cartridge department. Later that year he was mobilized as a member of the University of Birmingham O.T.C. In 1916 he was transferred to the Royal Warwickshire Regiment. He was demobilized in 1918 to undertake munition work, and the following year was appointed works manager of Cooper & Goode Ltd, Birmingham. Thereafter he became works manager, Hughes Stubbs Metals Co., 1920; works manager, Muntz's Metal Co., 1922; and technical director, Elliott's Metal Co. Ltd, 1924. Three years later he joined Imperial Chemical Industries Ltd as technical director, metals and ammunition division, Kynoch Works, later becoming managing director (technical), and then divisional chairman. He was elected to the Board of Imperial Chemical Industries Ltd in 1944. During the second world war, he contributed valuable service as director, small arms ammunition, Ministry of Supply, and later as director general, ammunition production. In 1945 he assumed responsibility for Royal Ordnance filling factories and explosives factories. He also served on a number of war committees. He was released from the Ministry of Supply in 1945 and resumed his membership of the Board of Imperial Chemical Industries Ltd, becoming responsible for the Metals Division. The following year he received the honour of knighthood; in 1952 the newly-established Insignia Award in Technology of the London City and Guilds Institute was conferred upon him; and in 1954 he received the honorary degree of LL.D. of the University of Wales in recognition of his work for industry and contributions to technological education. He retired in 1953. (*A.* 1918, *F.* 1945) *D.* 21.2.61.

Hugo Johann Strausz. *B.* 9.6.1886. *Ed.* Universities of Leipzig and Halle/Saale. M.A., DrPhil.(Halle). During 1915–18 he was engaged partly as a factory analytical chemist, partly as chief of the Imperial Soda Department of the German Government and partly on military duties in the chemical laboratory of an Austro-Hungarian Military Hospital. In 1919 he set up his own practice as a public analyst. He joined the Leo-Werke, Dresden, in 1924, as scientific director and in 1929 was appointed technical director. He came to this country as a refugee in 1939, and in 1942 joined Coty (England) Ltd as a consultant and technical adviser. The following year he took a similar post with Stafford Allen & Sons Ltd and later set up his own consulting practice. (*F.* 1948) *D.* 10.2.61.

Howard James Tabor. *B.* 24.6.1889. *Ed.* Sir John Cass Institute, 1905–10. He entered the Royal Mint as a laboratory attendant in 1904, became senior laboratory attendant, assay department, in 1909, and assayer's assistant in 1913. He served in the Royal Naval Experimental Station, 1918–19, and then returned to the Royal Mint. He remained there until his retirement in 1954, when he was senior experimental officer. The same year he was appointed M.B.E. (*A.* 1943) *D.* 26.2.61.

Arthur Rose Weir. *B.* 12.2.06. *Ed.* Municipal College, Bournemouth; King's College, London, 1926–29. B.Sc. He continued for a further two years at King's College as a research student and in 1931 was appointed teacher of chemistry and physics at the English Grammar School, Prague. Whilst there he was awarded the degree of R.Nat.Dr(Prague). He resigned in 1939 owing to the political situation and returned to this country, where he took a post as chemistry master at Epsom County School for Boys. In 1941 he was appointed teacher of chemistry and physics at the Czechoslovak State School, firstly at Whitchurch and later at Llanwrytyd Wells. He returned to Prague to resume his former duties but was forced to return once more to this country in 1948 owing to the change of régime in Czechoslovakia. He was appointed senior chemistry and physics master at Westonbirt School, near Tetbury, where he remained for the rest of his life. (*A.* 1930) *D.* 4.3.61.

THE REGISTER

NEW FELLOWS

(P) Allen, Peter William, B.A., PH.D.(OXON.)
(R) Bryant, Kenneth Conrad, M.A., B.SC.(OXON.)
(P) Cadogan, John Ivan George, B.SC., PH.D.(LOND.)
(P) Sadler, Peter William, B.SC., PH.D.(LOND.)

ASSOCIATES ELECTED TO THE FELLOWSHIP

(P) Alexander, Marcus Falk, B.SC.(BRIST.)
(Q) Bolton, Derrik, B.SC.(LOND.)
(P) Butler, Leslie Osgood, B.SC., PH.D.(LOND.), A.R.C.S., D.I.C.
(P) Collins, Ronald Bernard, B.SC.(LOND.), F.R.P.S.
(P) Cook, Harry Aaron, B.SC.(LOND.), A.R.C.S.
(P) Cotson, Sydney, B.SC., PH.D.(LEEDS)
(P) Davies, Jenkyn William, B.SC.(BIRM.)
(O) Dixon, Jean Pickering
Epstein, Joseph Alexander, B.SC., PH.D.(LOND.)
(K) Fitzpatrick, Joseph, B.SC.(GLAS.)

(P) GOODCHILD, Anthony Grayson, B.SC.(LOND.)
(C) HOLLAND, Geoffrey James, B.SC.(LOND.)
(T) HOLMES, Frederick, B.SC.(LOND.)
(P) JONES, William Owen, B.SC., PH.D.(WALES)
(P) LISTER, John Henry, B.SC., PH.D.(LOND.)
(EE) MONBIOT, Maurice Ferdinand, B.ÈS SC.(PARIS), M.I.CHEM.E.
(P) MULHOLLAND, Thomas Patrick Cunningham, M.SC., PH.D.(MANC.)
(N) NEALY, David, M.B.E., M.SC.(LIV.)
(P) NEWMAN, Dennis Daniel Ernest, B.SC., PH.D.(LOND.), D.I.C., A.R.C.S.
(H) NIX, Norman, B.SC.(NOTT.)
POWELL, Ronald James
(P) PRENTICE, Albert George, B.SC.(LOND.)
(T) ROBERTS, Iolo Francis, B.SC.(WALES)
(P) SANSOME, Arthur George, B.SC.(LOND.)
(OG) VARSHNEY, Ishwar Prasad, M.SC., PH.D.(ALIG.), DR ÈS SC. (PARIS)
(P) WESTWOOD, George Ernest
WHEELER, Desmond Michael Sherlock, M.A.(DUBL.), B.SC., PH.D.(N.U.I.)
(H) WRAGG, John Stanley, B.SC.(LOND.)

NEW ASSOCIATES

(R) AZIM, Shaukat, M.SC.(PANJ.), M.S.(ILL.)
(P) BLACKMAN, Lionel Cyril Francis, B.SC., PH.D.(LOND.)
(P) CERESA, Raymond John, B.SC., PH.D.(LOND.)
(Q) CLOSE, Robert Anthony, M.SC., PH.D.(BIRM.)
FEHENEY, John Patrick, M.SC.(N.U.I.)
(OG) KOCHHAR, Rajindar Kumar, B.SC.(PUNJAB), M.SC.(DELHI)
(W) NICKS, Peter Francis, B.SC., PH.D.(LOND.), D.I.C., A.R.C.S.
(W) PEARSON, Alan, B.SC.(BRIST.)
(OD) SRIKANTIAH, Hiriyanniah, B.SC.(MYS.)
SWARTZ, Alfred Mervyn, B.SC.(RAND)
WONG, Chi Shing, M.SC.(H.K.)

GRADUATE MEMBERS ELECTED TO THE ASSOCIATESHIP

(R) ANSELL, Frank Stanley, B.SC.(LOND.)
(S) BROWN, Joseph Foster Charlton
(H) CANSFIELD, Peter Evens, B.SC.(WALES)
(Y) COUSINS, Lionel Barry
(Q) EVANS, John Delwyn
(H) EVANS, Robert Gibson
(C) FREEMAN, Sidney William, A.C.T.(BIRM.)
(P) HAMMOND, Peter Ross, B.A., PH.D.(CANTAB.)
(Q) HOLDEN, Leslie Spencer
(C) HOPPER, John Edward
(OA) HUGHES, Alan Noel, B.SC., PH.D.(R'DG)
(O) JONES, Norman Allan
(A) KEIR, Hamish Alexander, M.SC.(ABERD.), A.H.-W.C.(EDIN.)
(P) MATTHEWS, Austin
(M) MEDCALFE, Terence
(C) MOSS, Arthur Donald, B.SC.(WALES)
(D) POARCH, Robert
(M) RAMSEY, David Michael, B.SC.(LOND.)
(H) SELKIRK, Charlotte Mary, D.L.C.
(P) STEVENS, John
(O) WILLIAMSON, William David

NEW GRADUATE MEMBERS

(S) ANDERSON, Wilfred de Ferry
(EE) BAKER, Billie
(C) BANFORD, Leonard
(SS) BARBER, Lawrence Edward, B.SC.(LOND.)
(P) BARNES, Brian Harold
(P) BEAN, John
(W) BEARD, Peter Stanley William, B.SC.(LEEDS)
(S) BEASLEY, Edward
(Q) BERGER, Eric, B.SC.(LOND.)
(O) BRASH, James Hugh
(R) BURRELL, Anthony Eric
(Q) BURROWS, Ronald
(E) CALDWELL, Derek Stanley
(U) CHAMBERS, Michael Robert
(O) CHESTERTON, Kenneth
(O) CLAY, William Maxwell
(P) CRESSWELL, Michael Alan
(P) DELANEY, Raymond Michael, B.SC.(LOND.)
(Q) DENTON, David Alan
(T) EVANS, Anthony James
(P) FELSTEAD, Peter
(P) FLEET, Bernard
(S) FLOOD, Alan Frederick
(EE) FOSTER, John George
(P) GILDERSLEVE, David Roy
(A) GORDON, George Park Douglas, B.SC.(ABERD.)
(E) GORE, Geoffrey Ivor
(P) GREEN, Brian James, B.SC.(LOND.)
(G) HALL, Raymond Frederick
(P) HANCOCK, John Alan, B.SC.(S'TON)
(Q) HARPER, James Stanley
(EE) HETHERINGTON, Derek Swinburne
(EE) HOPE, David
(O) HUGHES, Albert Douglas
(EE) HYDE, Thomas Gerald
(P) KIRK, Ronald Sydney
(O) KNIGHT, Harry
(O) LEATHER, Edward Harry
(P) LEWIS, Eric John
(E) LOBECK, Ronald Thomas
(Q) MACKIE, Anthony Grossart
(P) MATTHEWS, Bryan John
(H) MOORE, Leonard Francis
(P) MORRIS, Anthony Francis John
(C) PAGE, John Michael
(R) PESKETT, Francis John
(P) PINNEGAR, Michael Alan
(P) PITCHFORD, Peter Geoffrey
(T) ROBERTS, Roger Charles, B.SC.(MANC.)
(EE) ROSS, James Simpson, B.SC.(GLAS.)
(X) ROWE, David Alfred
(C) RUMSBY, Martin Gregory, B.SC.(BIRM.)
(O) SALVAGE, John Kenneth
(Q) SETTLE, Colin
(H) SMALLEY, Graham
(P) STARTUP, John William
(P) TILLMAN, John Edward William
(O) TIPLADY, Arthur
(P) TISSINGTON, Peter
(Q) TROW, Stanley Arthur
(C) TURNER, Michael Frederick
(Y) TWENTYMAN, Francis, B.SC.(LIV.)
(R) VAUTIER, John
(C) WALTON, John
(U) WEBSTER, Peter
(P) WILSON, William David
(H) WOODWARD, Geoffrey Michael

DEATHS

Fellows

(OG) COODE-ADAMS, William Roy Cecil, B.SC.(LOND.), M.A., M.SC., PH.D.(CANTAB.). Died 31 May, 1961, aged 65. *A.* 1921, *F.* 1943.
(N) FINN, Cornelius Philip, B.SC.(MANC.), M.SC.(LEEDS). Died 21 May, 1961, aged 80. *F.* 1917.
(P) MCNICOL, Reginald Arthur, M.SC.(LOND.). Died 12 April, 1961, aged 61. *A.* 1927, *F.* 1930.
(Q) NAYLOR, Donald Sanderson, B.SC.TECH.(MANC.). Died 7 January, 1961, aged 63. *A.* 1921, *F.* 1927.
(P) WORDSWORTH, Charles Harcourt, B.SC.(LOND.). Died 1 June, 1961, aged 50. *A.* 1939, *F.* 1942.

Associates

(K) BELL, Herbert Henry, B.SC.(GLAS.). Died 3 April, 1961, aged 61. *A.* 1924.
(L) RITCHIE, Thomas, B.SC.(GLAS.). Died 30 May, 1961, aged 56. *A.* 1929.

Erratum. In the list of New Associates (*J.*, 195) for Appa Rao, Ummrthala, read Appa Rao, Ummethala.